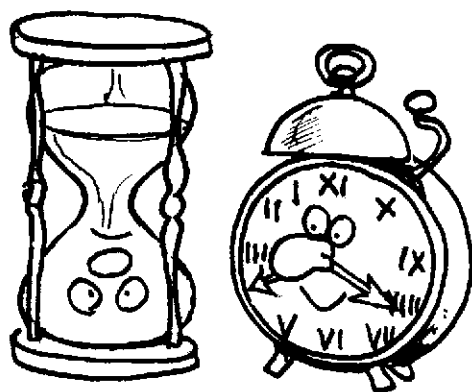


Association Savoir sans Frontières

The Chronologicon

Jean-Pierre Petit

Translated by John Murphy



<http://www.savoir-sans-frontieres.com>

The Association Knowledge without Borders, founded and chaired by Professor Jean-Pierre Petit, astrophysicist, aims at spreading scientific and technical knowledge in as many countries as possible and in as many languages as possible. To this end, all his popular scientific works, which cover a period of thirty years, and more particularly the illustrated albums he has created, are now freely accessible. Anyone is now free to duplicate the present file, either in digital form or in the form of printed copies and circulate these copies to libraries, within the context of schools or universities or associations whose aims would be the same as the association, provided that they do not derive any profit from this circulation and that they do not have any political, sectarian or confessional connotations. These pdf files may also be put on line in the computer networks of school and university libraries.



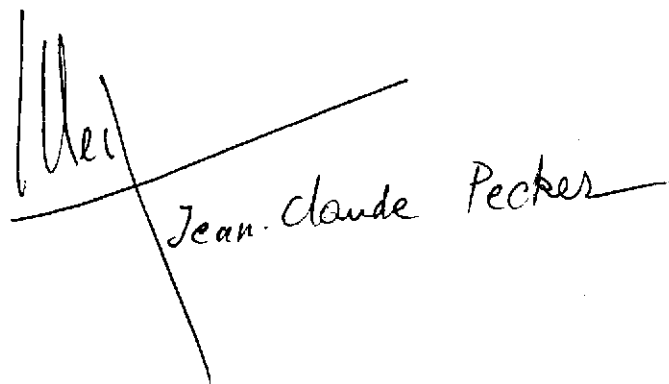
Jean-Pierre Petit intends to create numerous other works which will be accessible to a larger audience. Even illiterate people will be able to read them because the written parts will “speak” when the readers click on them. Thus it will be possible to use these works to support literacy schemes. Other albums will be “bilingual” in so far as it will be possible to switch from one language to another selected language with a mere click. Hence another tool made available to develop language skills.

Jean-Pierre Petit was born in 1937. He made his career in French research. He worked as a plasma physicist, he directed a computer science centre, he has created softwares, he has published hundreds of articles in scientific magazines, dealing with subjects ranging from fluid mechanics to theoretical cosmology. He has published about thirty books which have been translated in numerous languages.

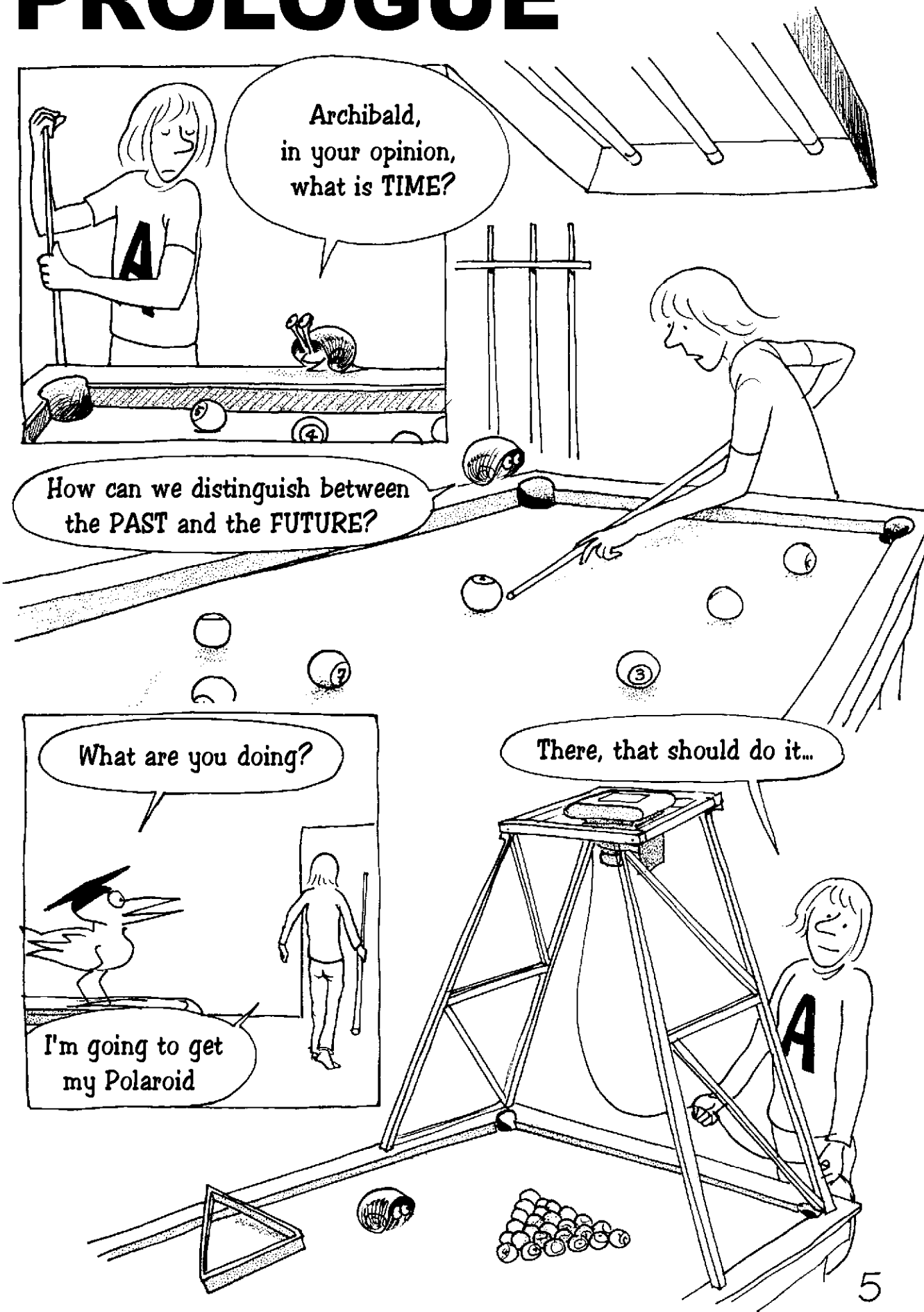
The association can be contacted on the following internet site:

<http://savoir-sans-frontieres.com>

Lanturlu rime avec hurluberlu... Surtout ! Mais Kepler, Newton, Darwin, et même Einstein n'étaient-ils pas, eux aussi, un peu, des hurluberlus ? Si la science n'avancait que sur les sentiers battus, elle n'avancerait guère !

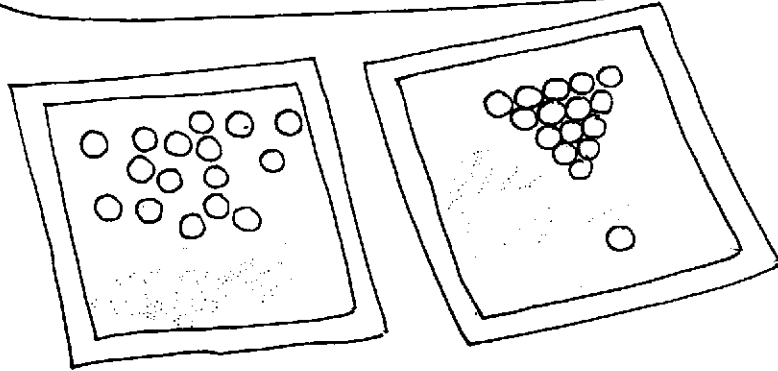
 Jean-Claude Pecker

PROLOGUE

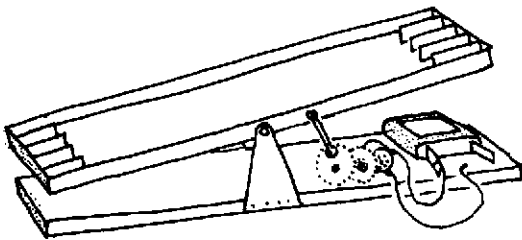


Sophie!

Look at these two snaps.
One is POSTERIOR to the other. There must
be a way of sorting these two pictures by
time so as to determine their CHRONOLOGY.

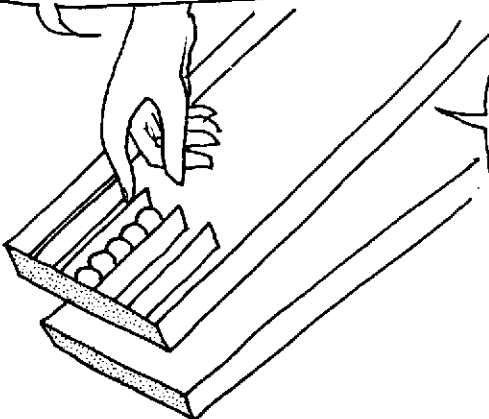


PROBABILITY



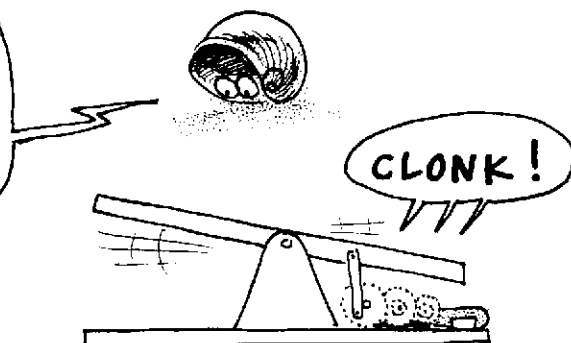
It's a good idea but
here's a machine
which will show it
a lot more clearly.

It consists of a plate
oscillating around an axis
and which includes systematically
ordered compartments

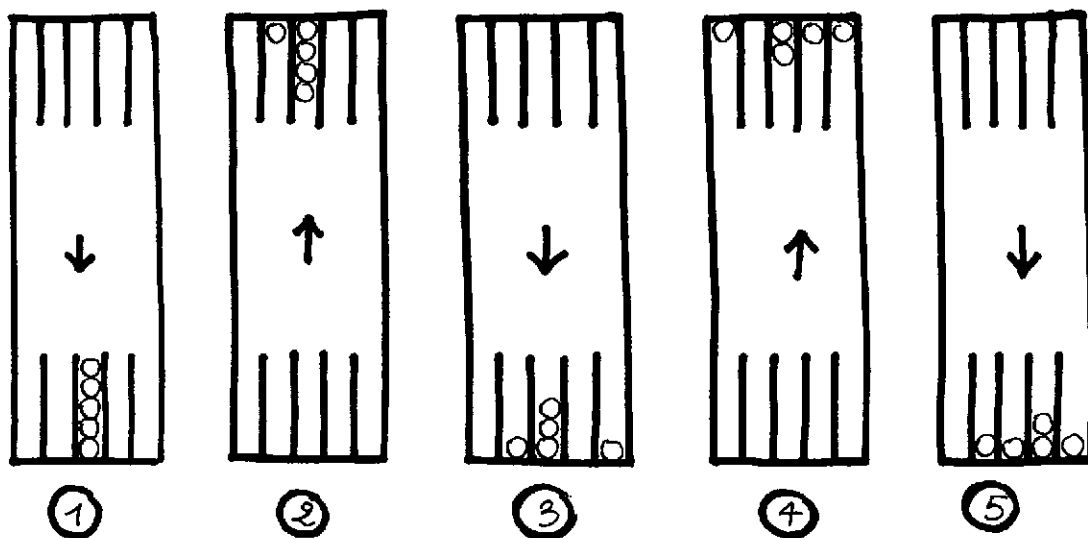


Before starting the machine
I put five balls into
one of the compartments,
the centre one for instance

Right, it's working. The plate, whose axis is perfectly horizontal, oscillates gently which makes the balls move from one edge to the other.



Look, the tiny irregularities in the machine and air turbulence makes it that the balls don't remain in the original compartment but have a tendency to migrate towards the adjacent compartments



The balls go backwards and forwards but don't seem to want to end up in the same slot.

Because such a situation is too IMPROBABLE.



What do you mean?

Think about it. There is one chance in five that a ball will end up in a given slot, number 2 for example. There is also one chance in five that it will already be one there. So there is one chance in twenty-five that two balls end up in the same slot.

PROBABILITIES multiply
so that makes
 $1/5 * 1/5 = 1/25$

In the same way, if you throw
three balls at random you'll have
 $1/5 * 1/5 * 1/5 = 1/125$,
one chance in one hundred and
twenty-five of ending up with
all the balls in the same slot.

Which corresponds to one chance in $5 * 5 * 5 = 125$
and that to one chance in $5^5 = 3125$,
so a probability of $1/3125 = 0,00032$.

If we consider all the slots to be equivalent,
the probability of five balls ending up in the same slot
is $P = 5 * 0,00032 = 0,0016$

If all the slots are considered to be the same then these are the probabilities attached to each configuration.

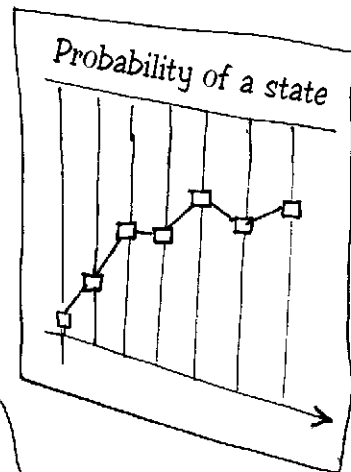
$$\begin{aligned} & \text{oooo} \longrightarrow P = 0,0016 \\ & \text{ooo} + \text{o} \longrightarrow P = 0,032 \\ & \text{oo} + \text{o} + \text{o} + \text{o} + \text{o} \longrightarrow P = 0,0384 \\ & \text{o} + \text{o} + \text{o} + \text{o} + \text{o} + \text{o} \longrightarrow P = 0,064 \\ & \text{ooo} + \text{o} + \text{o} \longrightarrow P = 0,192 \\ & \text{oo} + \text{o} + \text{o} + \text{o} + \text{o} \longrightarrow P = 0,288 \\ & \text{o} + \text{o} + \text{o} + \text{o} + \text{o} + \text{o} + \text{o} \longrightarrow P = 0,384 \end{aligned}$$

Odd: one ball in each slot is not the most probable?

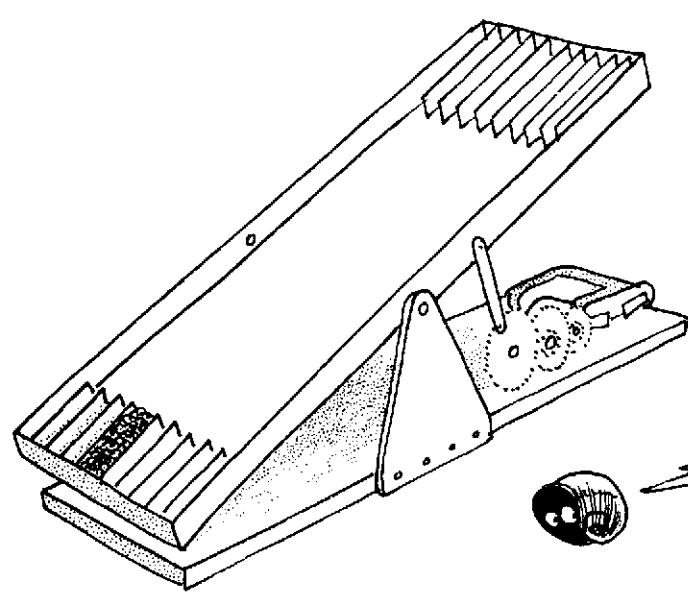
Let us note the probabilities of successive configurations according to our experience.

SECOND PRINCIPLE

It's quite clear Sophie. The probability of a state increases rapidly followed by states with the highest probabilities.



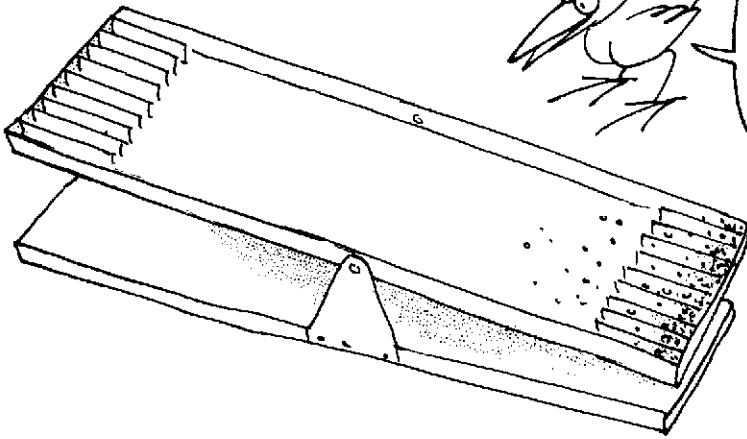
Try with 10 slots and 1000 balls



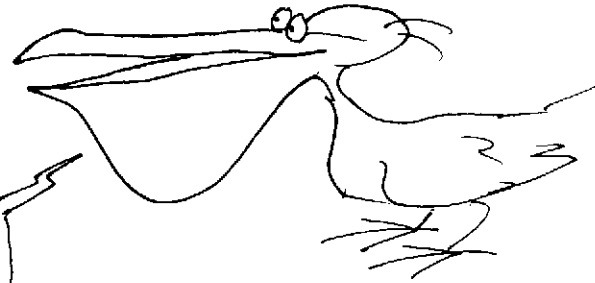
Archibald used gunshot.
The probability of finding the
1000 balls in the same slot
is $(1/10)^{1000} \approx 10^{-300}$, that is
 $P = 0,0000...0001$
(998 zeros!).
Extremely low therefore.



When the machine is started,
the balls tend to be
distributed practically
equally in the different slots



All observed states are therefore
very close to an average state
where all the slots will contain
the same number of balls (*).



We schematize this result in the form
of the **SECOND PRINCIPLE** by saying that
**ANY ISOLATED SYSTEM TENDS TOWARDS
ITS MOST PROBABLE STATE.**



(*) A system having this sort of statistical stability is called **ERGODIC**.

What is a nonisolated system?

Here's one: when Archibald intervenes to arrange the balls.

Look Sophie, I've improved the system. I've arranged the slots and the shot on the plate and can design any form I wish with them.

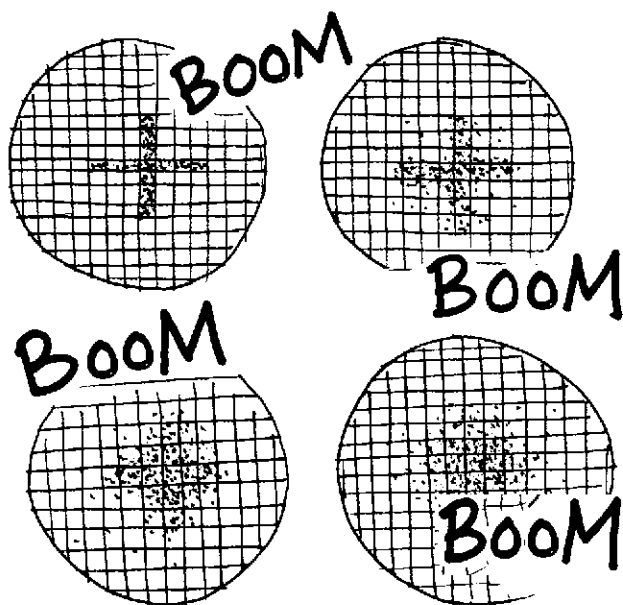
Unless he's a vegetarian that is.

Isolated system ready to converge towards a state of maximum stability.

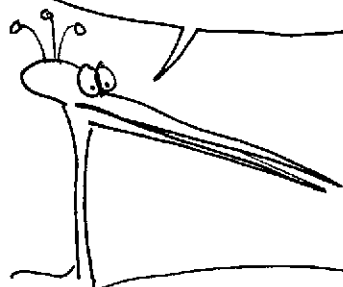
We cover everything with a transparent bell jar

And?

Now I just have to give it
a few taps with a hammer
underneath.



What's happening?
Are you killing someone?



No, Archibald is just making
a system tend towards its
state of maximum probability.

It's clear.
The message is becoming more
and more illegible. **INFORMATION**
degrades progressively.



In other words, I have a solution
to **CHRONOLOGICALLY** classify two
states of an isolated system.
The one with the **MOST ORGANISED**
STRUCTURE is the oldest.



irreversibility

You see, Archibald, natural diffusion will progressively destroy the message we wrote in the sky.

OK?

But we can't ignore the possibility that these molecules of colouring be able to regroup themselves and reconstitute the message.

Eurgh!

Just as we can't totally exclude the possibility that a very lucky hammer blow will rebuild the cross you had earlier.

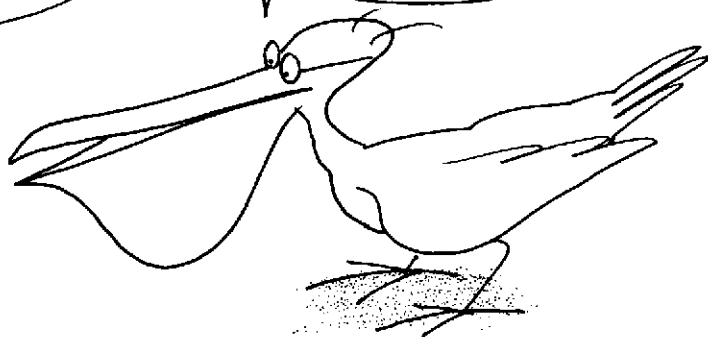
Or that the molecules of a colouring with the same density as water will somehow reform themselves into the original drop.

But as these probabilities are tiny, we'll consider them to be negligible

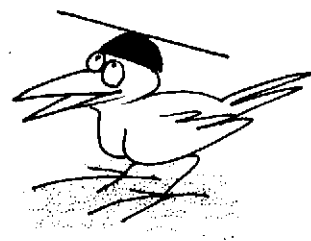
So the Universe is irremediably
moving towards **CHAOS**.
Vanilla ice-creams melt,
mountains crumble.



In short **IT'S ALL
GOING WRONG**.



We generally associate this phenomenon
with the irremediable growth
of a quantity called **ENTROPY (*)**.



Well that's very upsetting.
I think I'll make a cup of tea.

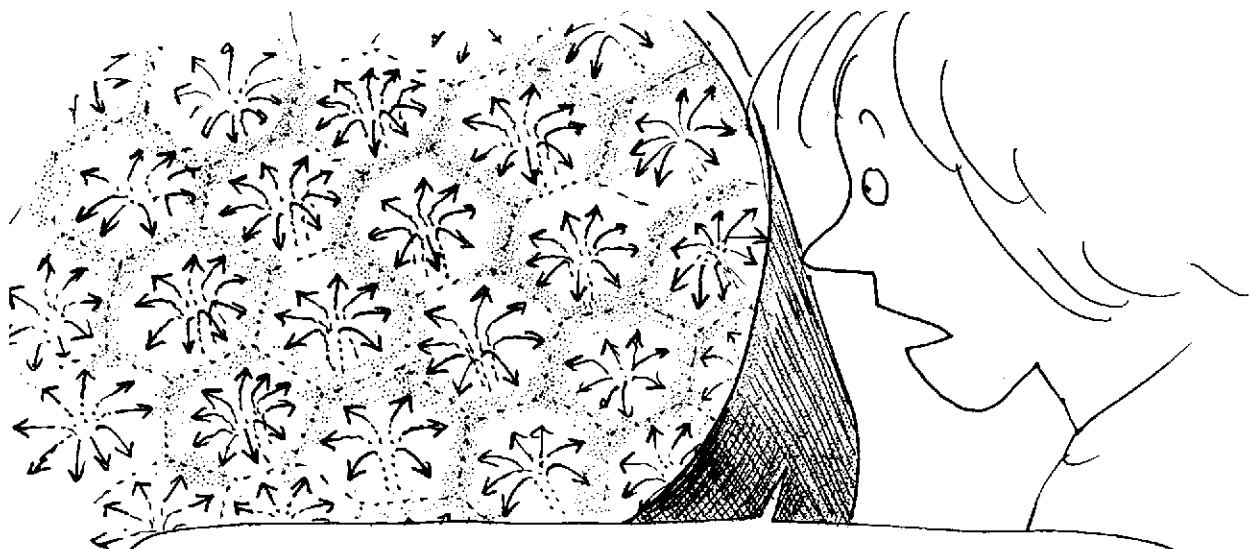


But it seems to give the
answer. As **ENTROPY** can
be **MEASURED**, we can
classify a system's states
CHRONOLOGICALLY.

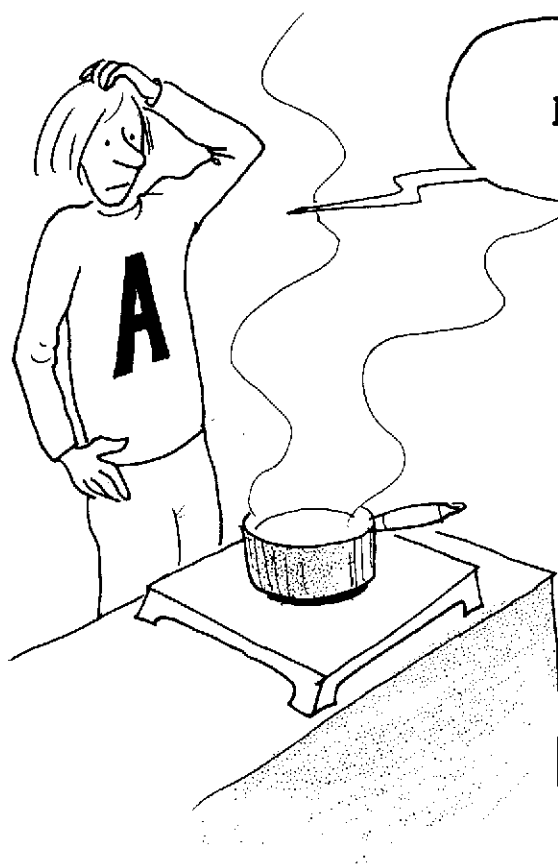


(*) If P is the probability of a state, entropy is $S = -P \log P$,
where \log means logarithm.

DISSIPATING CELLS



There's a thing! When I heat water a swirling hexagonal mesh system appears, there where there was nothing before, yet my hotplate gives a homogenous heat.

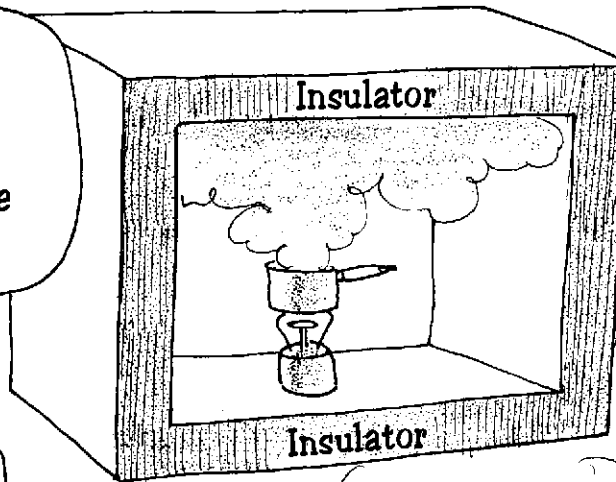
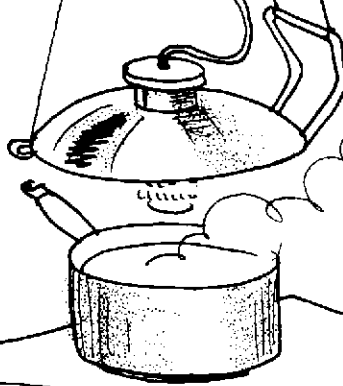


By evaporating the water
I thought I was creating disorder
and in fact I've got order!?!

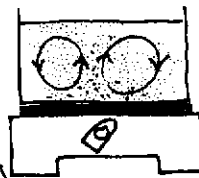
Does that means that
boiling water has the
power to lessen entropy?



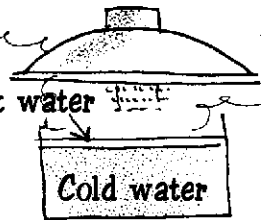
That simply means that this idea of **ENTROPY** only enters into it for **THE WHOLE OF AN ISOLATED SYSTEM**, that is to say the ensemble heater-saucepan-water-atmosphere.



Convection

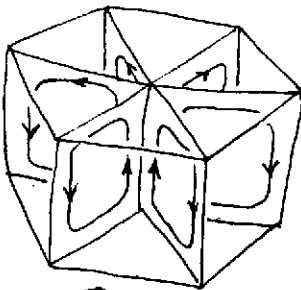


Hot water



No convection

It's also perfectly possible to make all the water evaporate without any swirling, with no convective movement, by heating it with radiation from above, using a simple parabolic radiator (*)



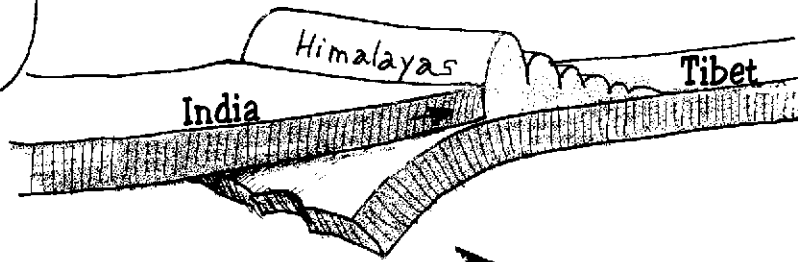
It isn't the return to **AMORPHISM** that characterises the increase in entropy of a system. The **DISSIPATING CELLS**, when they appear, cause an acceleration of evaporation, a global entropic increase.



Mountains crumble by themselves but the water carried there by clouds accelerates their erosion.

(*) See "If we flew?"

But aren't there also mountains on earth that are being formed, such as the HIMALAYAS?

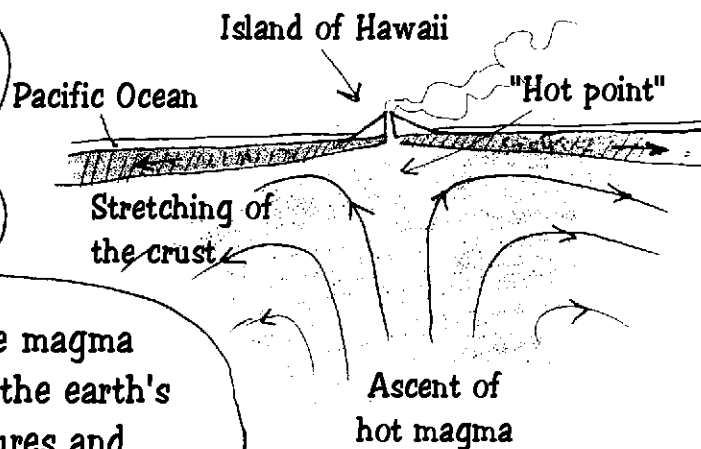


Effectively yes, it is thought that the "Indian plate", by squashing Tibet, created the mountains.

All that is just a result of convective currents which animate the MAGMA and help it release the heat at its centre, which is maintained by the disintegration of primitive Uranium 235



You mean there are convective cells in the magma?



Of course, and the magma movements pull on the earth's crust which fractures and creates something like a Hawaiian type volcanism.

Of course if you pull on the scabs you can never heal up the wounds.

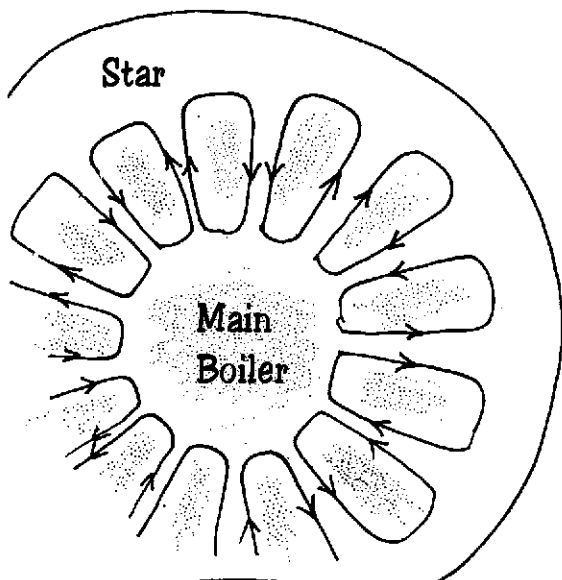
We're surfing on a three dimensional stewpot that we call Earth.

What!?!

Hang on...that's all very nice but where does the Uranium come from?

A star, at the time of its explosive end, when it was transformed into a SUPERNOVA (*)

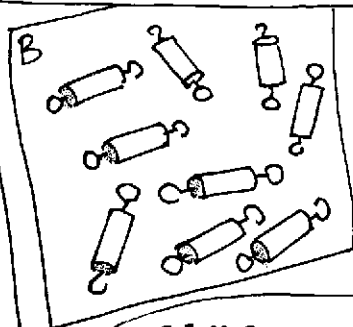
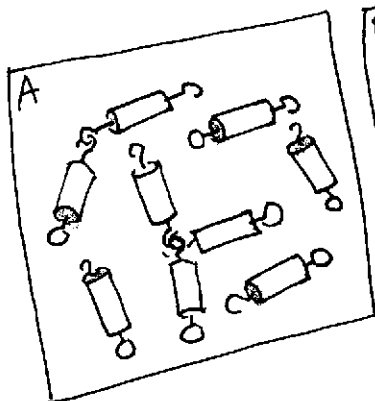
There are also powerful convective currents in the stars that carry the heat created by the fusion of hydrogen at their centre towards the periphery.



The saucepan, Earth, the solar star, all function with the help of DISSIPATING CELLS.

MORPHOGENESIS

Archibald, these objects were in a box that we shook. Can you class the two orders of content chronologically?



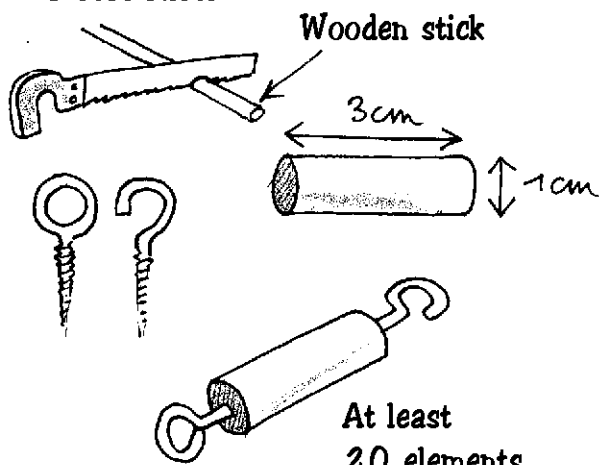
Well I suppose they are in order. When they were shaken the structures of two or three elements would have been dislocated.

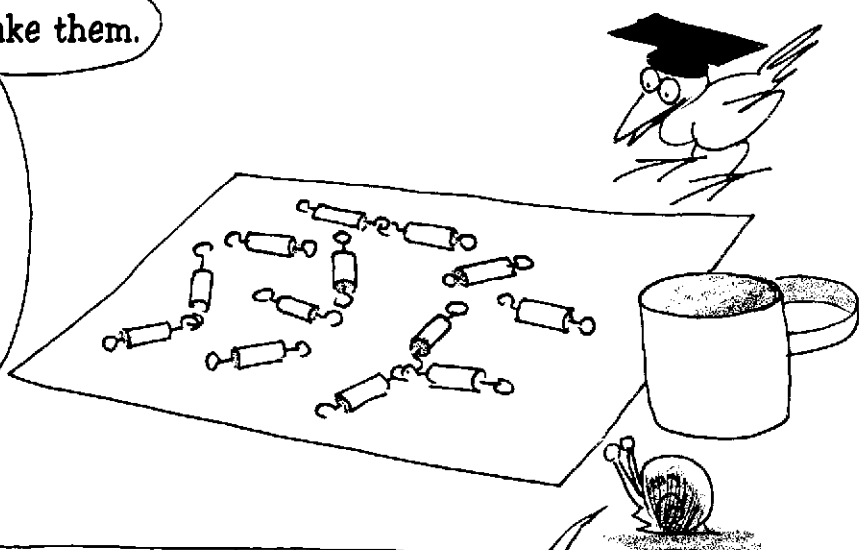
What are you doing?

It seems I mucked it up again. The only solution is a return to experiment.



MATERIAL:



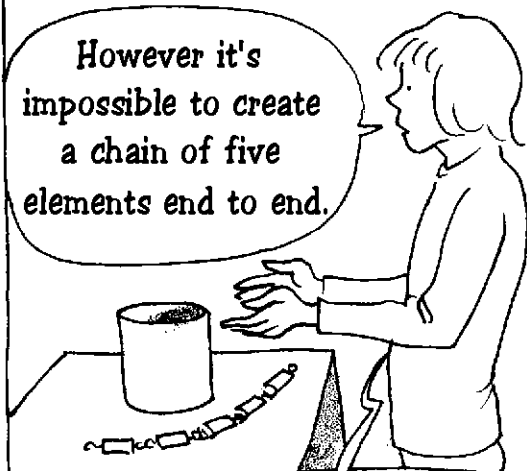


Well there's a thing! Despite several tries, Archibald always ends up with an assembly of two, or three elements

That simply means that for this particular system, it is the **MOST PROBABLE** configuration.

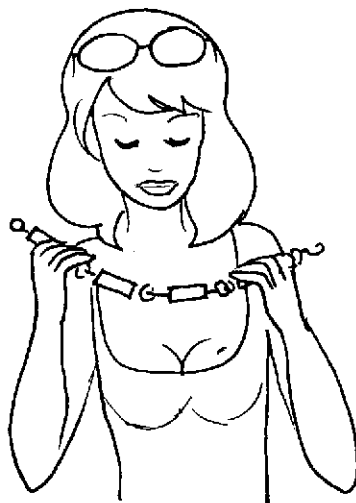
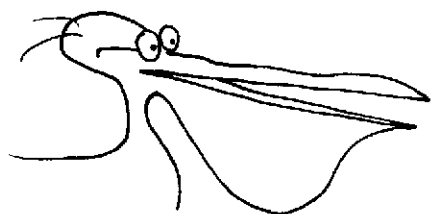


However it's impossible to create a chain of five elements end to end.



And if I introduce such a structure into the box, it disappears when I shake it!!!

If you can't synthesise this "mechanical polymer" it's simply because it's very improbable.

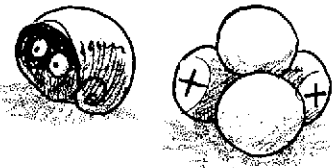


You know, Nature is made
in such a way that when something,
at a given instant, is **HIGHLY PROBABLE**
it will inevitably happen

And I suppose that conversely,
if something is very improbable
it won't happen.

And when something has
an extremely small chance of
happening during the lifetime
of the Universe,
we can consider it **IMPOSSIBLE**.

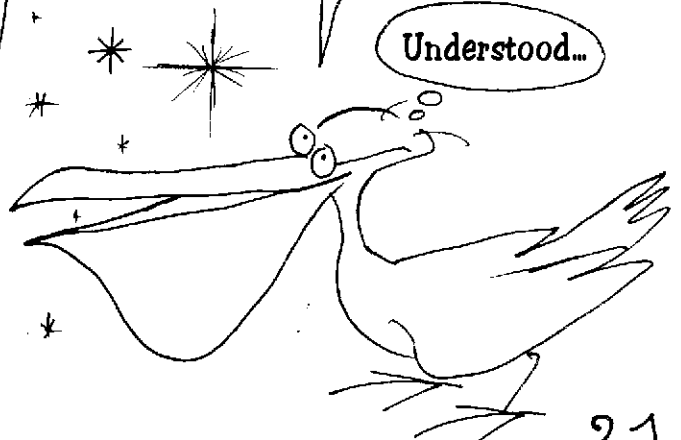
The formation of helium
at the moment of the **BIG BANG**
was extremely probable.
So it exists in the Universe!



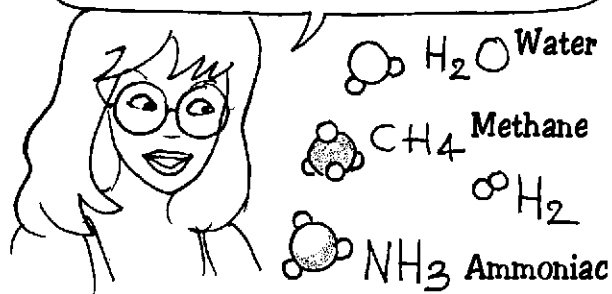
However, because of the
extreme dilution in the galactic
ether, we have calculated that
the sun has just one chance in
ten million of meeting another
star during the next ten thousand
million years.

We therefore consider
this **EVENT** to be an
IMPOSSIBILITY.

Understood...

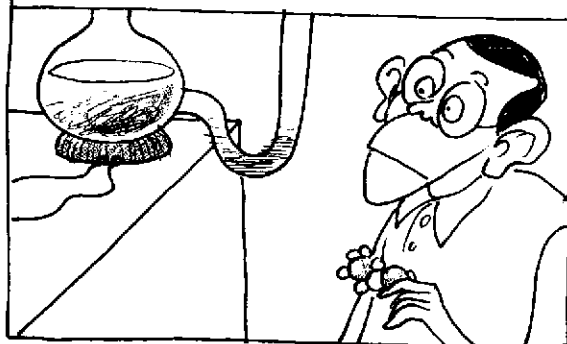


Water vapour, methane, ammoniac and hydrogen are all simple molecules, very symmetrical and comparable with the assemblies we had earlier

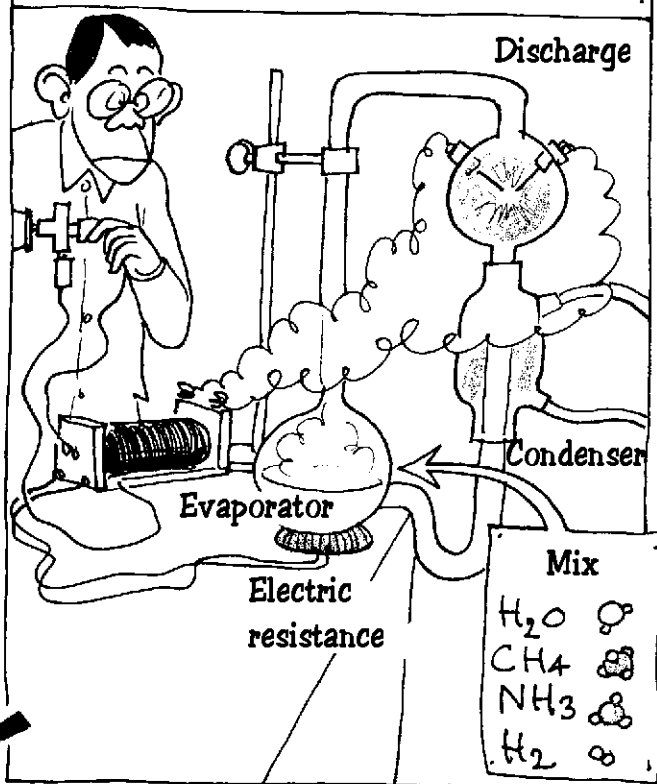


They were present therefore in the primitive atmosphere of our planet

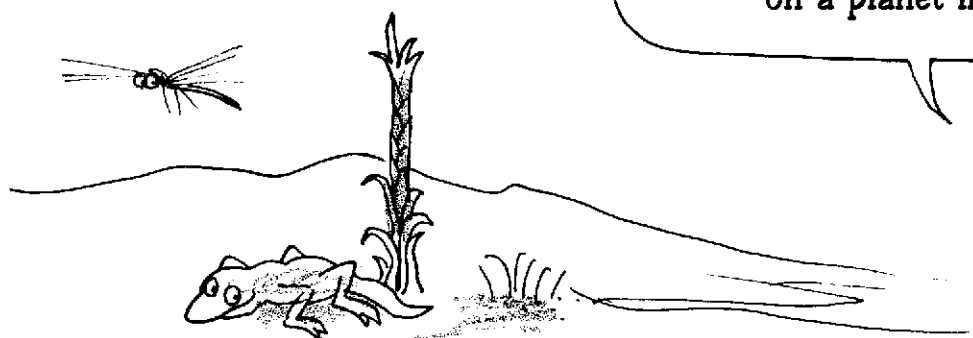
A week later the mix, colourless, had turned orange because of the presence of amino-acids, molecules made up of about 15 atoms.



In 1950 a young student, Miller, decided to introduce these elements into a container and "shake" them by means of a simple electric discharge.



As in their turn these molecules are elements in the constitution of **PROTEINS**, we began to get used to the idea that **LIFE** must be not only a probable phenomenon but may even be **INEVITABLE** on a planet like Earth.



NEGENTROPY?

Right, let's recapitulate.
There are systems which simply
tend towards **DISORDER**. Then
there are those which secrete
DISSIPATING STRUCTURES but
which, at the end of the day,
arrive at the same result.

And then there are systems
that tend towards **ORDER**,
which will reduce entropy.
They are therefore **NEGENTROPIC**...

...like this game, or
the game of **LIFE**

SNAP!

Apparently! And how did you produce
the energy used to shake up the container,
or create the spark needed to start
molecular syntheses?

Like that?

We had to burn some petrol
and allow water to descend
through a tube, or "burn"
a few molecules of sugar...



And do you think that LIFE
is free? What makes trees grow,
apples ripen?



Eh...

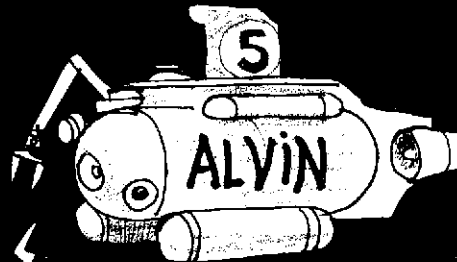
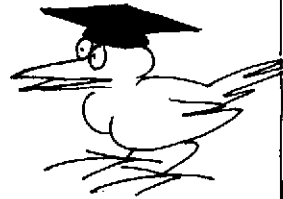
It's the Sun that
supplies the energy.
That's the motor of life.



Very good
Tiresias.

But the sun isn't always
the source of energy for life.

It's true. We have to consider
the **ENSEMBLE OF THE SYSTEM**,
that is to say the **BIOSPHERE**,
its support, the **BIOTOPE**, plus the
energy source. Then there can be
a global increase
in the entropy system.



Life, in the depths of the ocean, uses
the energy of submarine hot water

It doesn't
matter (*).

Blow, so LIFE is just
another dissipating cell?

No, seriously, the finality
of living things is not **JUST**
to dissipate energy.

In fact though, we don't
yet have a clear reply
to that question.

H BOMB

ENTROPY

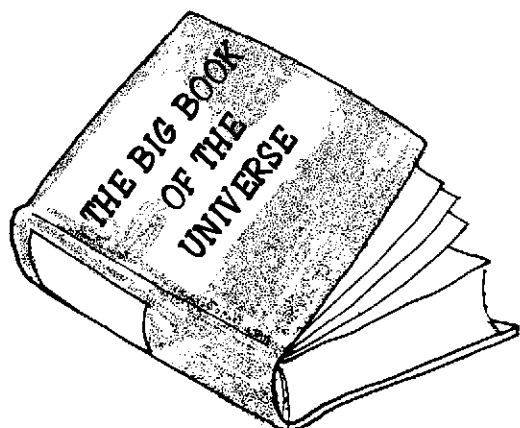
Entropy, time, probability,
it's all getting mixed up in my head.

Maybe taking it back
to the origin of the Universe
when **EVERYTHING BEGAN**.

NONE of that
makes **ANY SENSE**

(*) This is all explained in the **BIOLOGICON**.

Life, planets, the stars,
it's all too complicated!
Wasn't there any time in the past
when the Universe was easier
to understand?



Let's look at the history
of the Universe as written
down by mankind.

Let's see... $t =$ one hundred
million years. That corresponds
to the birth of galaxies.
No... it's still too complicated



Let's try $t = 100,000$ years

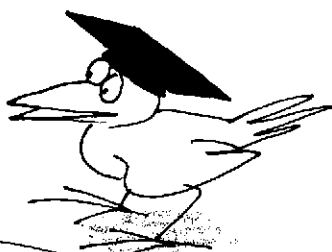


Goodness!?! Then the Universe
is perfectly homogenous! (*)

(*) See "A Thousand Billion Suns".

How can a perfectly homogenous Universe evolve, seeing as **NOTHING** happens?

Homogenous populations don't have history.



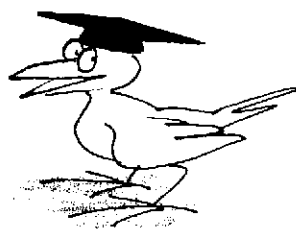
How can time pass when there isn't the slightest tendency towards disorder, nowhere, given that this disorder is at its **MAXIMUM!**

Wait, there is something happening in fact because the Universe is **COOLING DOWN.**

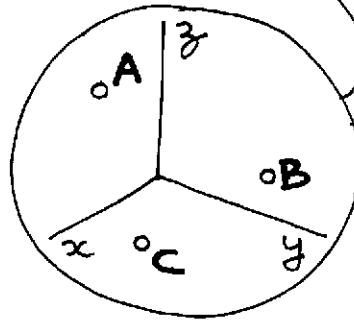
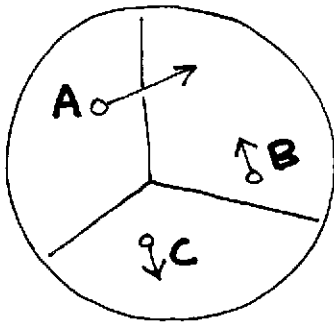


You need more than data on their positions to completely describe a system of particles at a given moment, you also need their velocities.

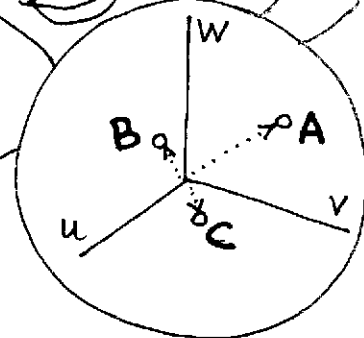
Yes, for **VELOCITY** is also **INFORMATION.**



Instead of using arrows
we can represent particles in two
spaces of three dimensions:
POSITION SPACE and **VELOCITY SPACE**.



POSITION



VELOCITY

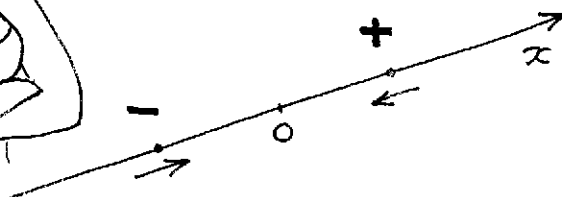
This complete description using
six coordinates can be associated
with a space of six dimensions
called **PHASE SPACE**.



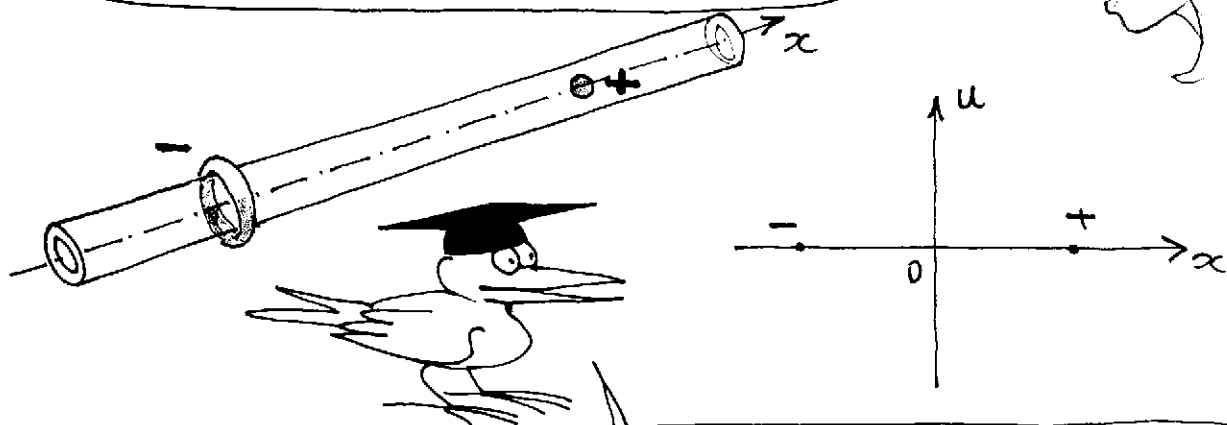
Let us simplify the situation to the extreme.
Let's consider a universe with just one dimension
in space (a simple line) where two punctual
objects, supposed to represent particles with
opposing charges, are mutually attracted.



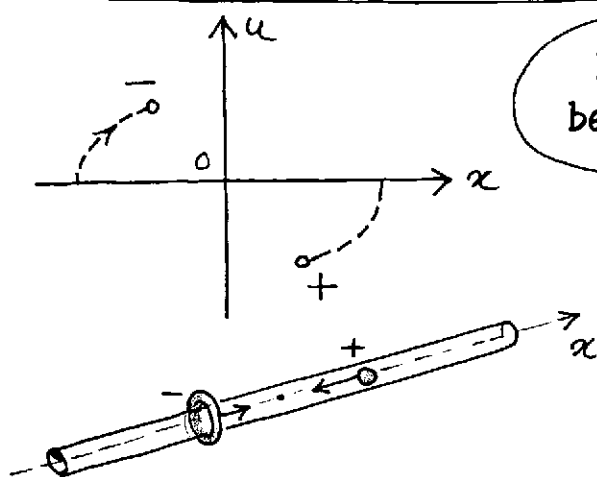
But how will they
manage to meet each other?



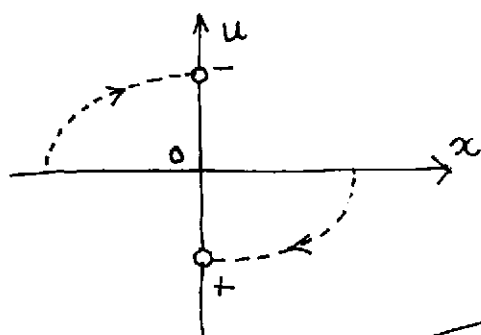
Good question! We just have to positively charge a small ball moving in a tube and negatively charge a ring, for which the tube will also serve as a guide.



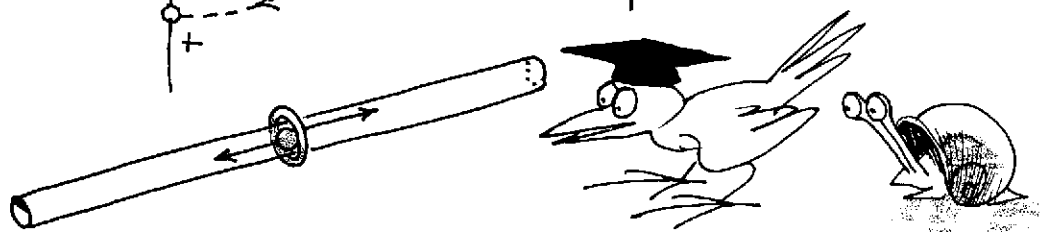
If we represent this system in a PHASE SPACE (x,u) where x is the coordinate of POSITION and u the coordinate VELOCITY, and with the particles given an initial speed of zero, we get the following schema.

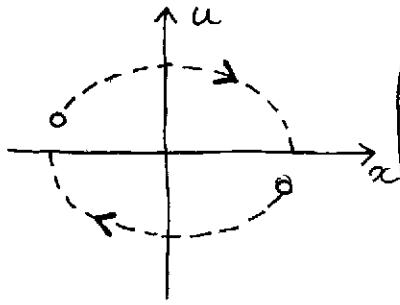


Particles which are attracted begin to fall towards each other.

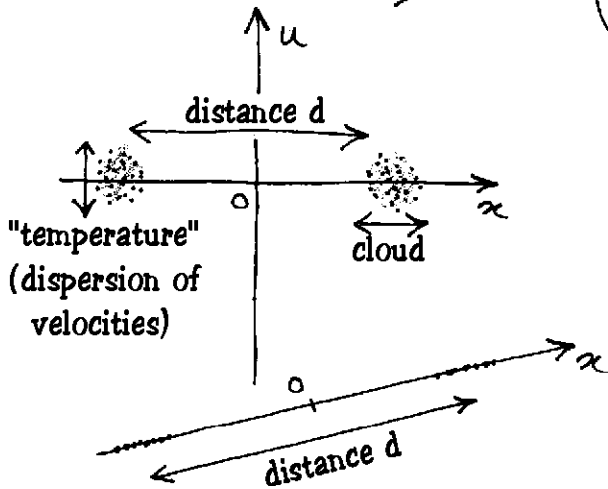


Here they meet at maximum speed.



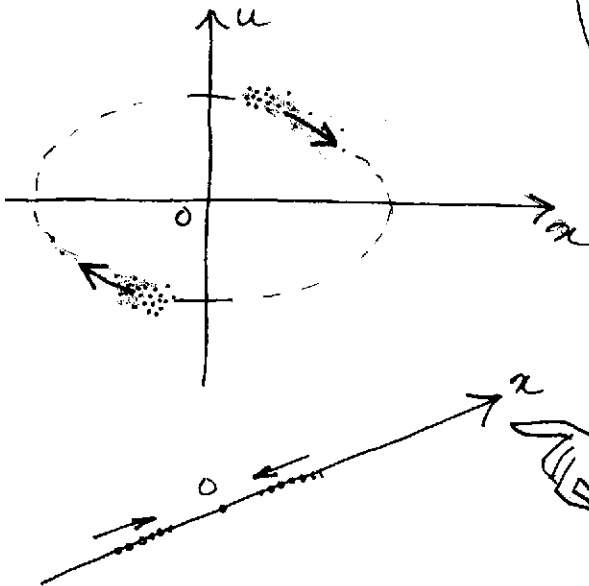


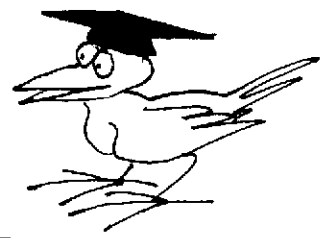
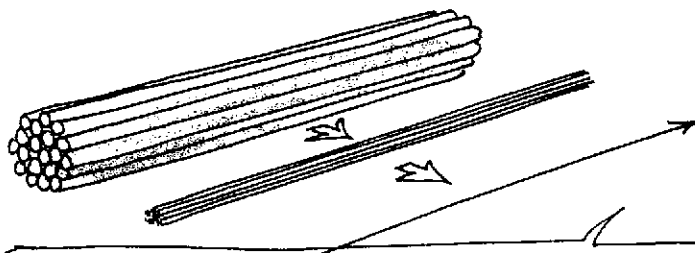
The to-and-fro movement, the oscillation of charges around their common centre of gravity, will give elliptical trajectories in the phase space.



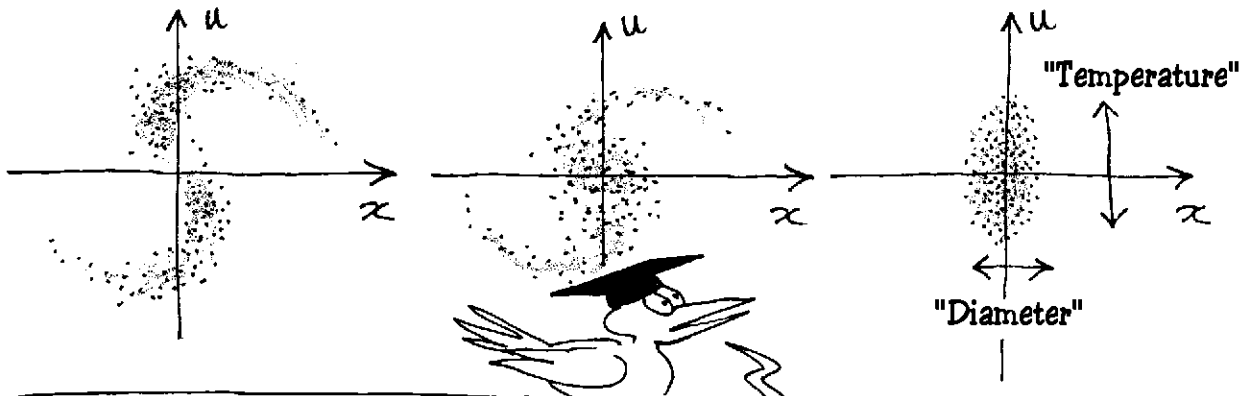
The schema describes two particle ensembles situated at a certain distance, with a globally zero speed (they are very close to the axis OX) but presenting random THERMIC AGITATION velocities.

These ensembles will "fall" towards each other under the effect of mutual attraction.



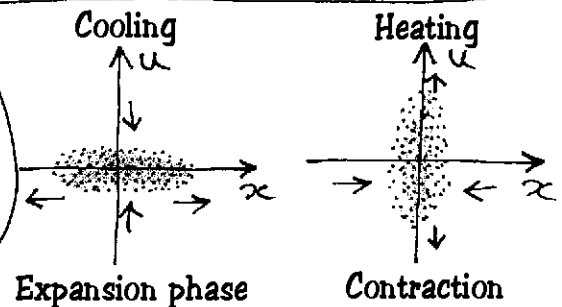


Technically we could allow particles to cross each other without telescoping into each other by putting them in extremely thin tubes.



The two clouds amalgamate into one, unique cloud.
The acquired **KINETIC ENERGY** is randomly redistributed and the result is "heating", a spreading according to the dimension velocity u . The surface occupied by all these particles will increase globally. But this surface IS, precisely, **ENTROPY**.

The system will oscillate, **EXPANSION** being synonymous with a reduction in speed (of thermic agitation), and of **TEMPERATURE**.
The inverse process takes place during contraction



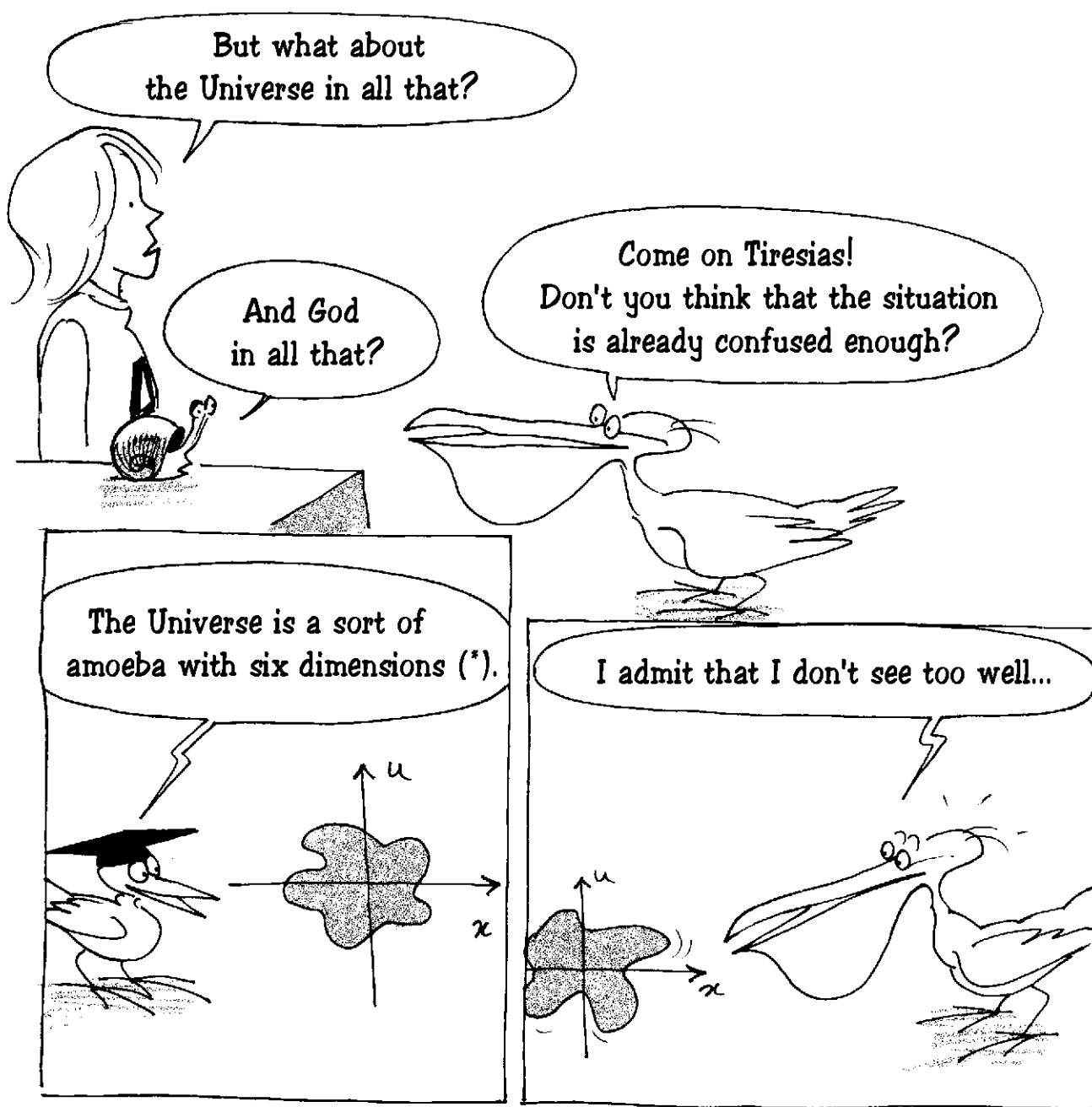
It looks like a two-dimensional soap bubble.



But then the oscillation of this strange amoeba, an inhabitant of a **PHASE SPACE**, will happen with a constant area, a **CONSTANT ENTROPY** (*)

(*) In the chosen example particles do not meet.

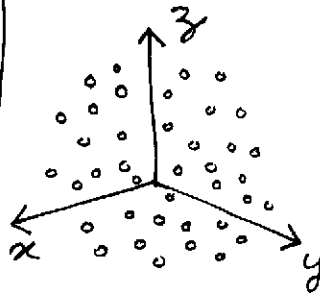
FIRST COSMOLOGICAL PARADOX



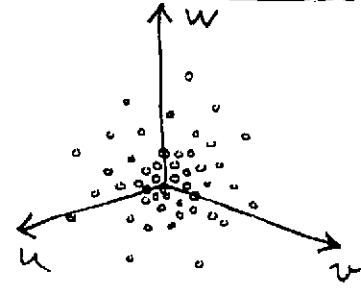
(*) See The Geometrical.

To represent this six dimensional PHASE SPACE (3 for position and 3 for velocity), you just have to 'unfold' it according to two three dimensional representations.

Position space



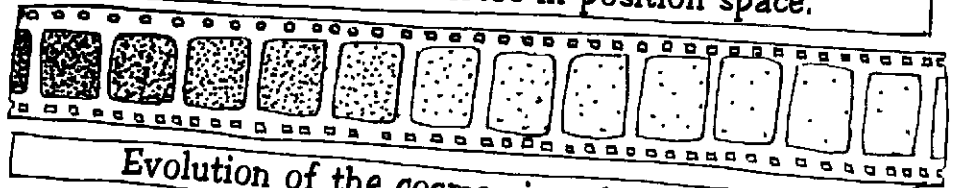
Velocity space



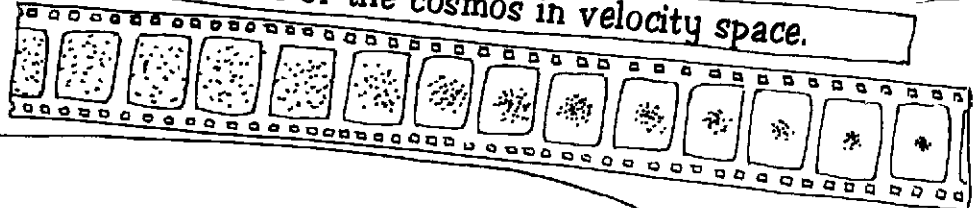
In POSITION SPACE the Universe is diluted and this dispersal is synonymous with DISORDER. Inversely, agitation speed diminishes. However in its representation in VELOCITY SPACE, the Universe condenses, which translates as a tendency towards ORDER.



Evolution of the cosmos in position space.



Evolution of the cosmos in velocity space.



Globally, in this six dimensional representation the Universe's ORDER STRUCTURE remains invariant. ENTROPY, which is its HYPERVOLUME, or the product of its volume in position space by its volume in velocity space, does not vary (*)

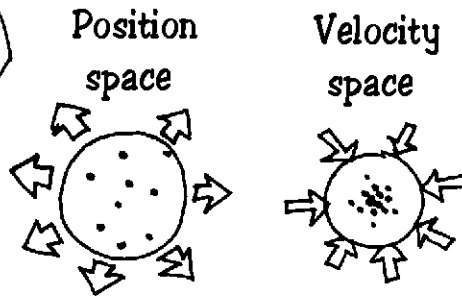
In other words, in its six dimensional representation the cosmos is an incompressible fluid.



(*) LIOUVILLE's theorem, French mathematician (1802-1882).



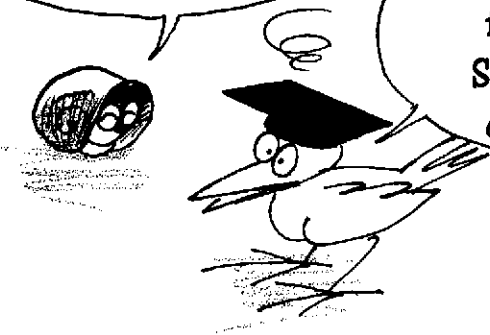
In other words, it dilates
on the POSITION side but gets
thinner on the VELOCITY side



But let's see, as the SECOND PRINCIPLE
also states that ENTROPY INCREASES WITH
TIME, how can there be an EVOLUTION
FROM THE COSMOS TO CONSTANT ENTROPY?

In effect this paradox
is one of the weaknesses of classic
cosmological models.

It's the cosmic
summit, ha! ha!



In short, just because a model is developed
from very scholarly calculations, like the
STANDARD COSMOLOGICAL MODEL, that
doesn't mean it is automatically coherent.

But doesn't Science have a partial response to give, a bit of a theory?
Anything in fact?

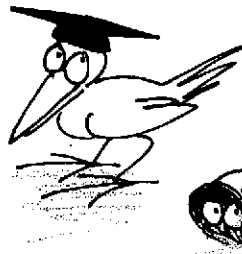


Alas the immense temporal plains covered by constant entropy is one of the weaknesses of our vision of the Universe.

So time advances
and we don't know why.
There's a thing!

And no-one
mentioned it
to me.

I wasn't aware of this
paradox either. It's true
that scientists don't shout
it from the rooftops.



All the same...
it hurts.

As well as that, not only is this **ENTROPY**
conserved with the passing of time, but it is
also at **MAXIMUM, DISORDER** being at its
highest point at the time of the **BIG BANG**.




SECOND COSMOLOGICAL PARADOX

Well it isn't difficult, **COLLISIONS** are what create and maintain disorder in a particle system, in a **FLUID** such as the **PRIMORDIAL COSMIC FLUID**.

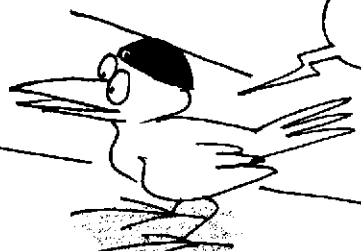
Yes it's clear:
the primitive Universe must
have been very **COLLISIONAL**.

From whence comes
the **ORIGINAL DISORDER** created and
maintained that we observe still (*)


(*) In effect the Universe is extremely **HOMOGENOUS** in all directions of space.



Unfortunately we find the exact **OPPOSITE**:
the primitive Universe would have been
perfectly **NON-COLLISIONAL**.



What do you mean?



Well, the primitive Universe is like a
dilating billiard ball but it dilates so
rapidly that particles can't even meet
each other (*), even when they move
at the **SPEED OF LIGHT**.

You mean that in this primitive Universe particles distance
themselves from each other at a speed **SUPERIOR TO THE SPEED
OF LIGHT!** That's absurd.



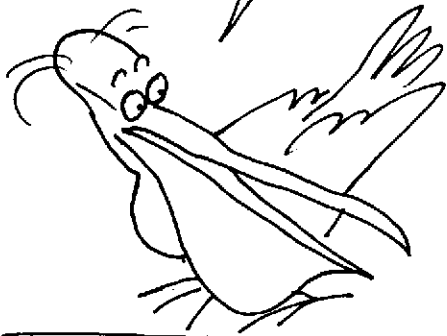
I know...



Let it go Tiresias, in such
cases it's better not to insist.

(*) See Annex B

Maybe God created a homogenous universe.

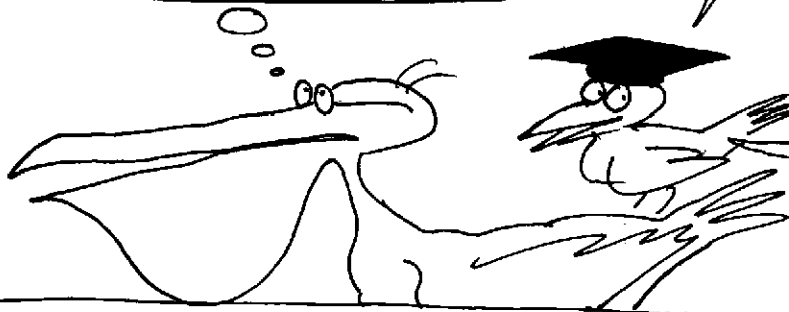


Hola, in science when you bring God into the argument things are really going badly!...



It's odd. In these comic books, up until now, everything has been going fine but here everything seems to be mixed up.

It seems to point to a need to go digging into the **ORIGIN OF THE UNIVERSE**



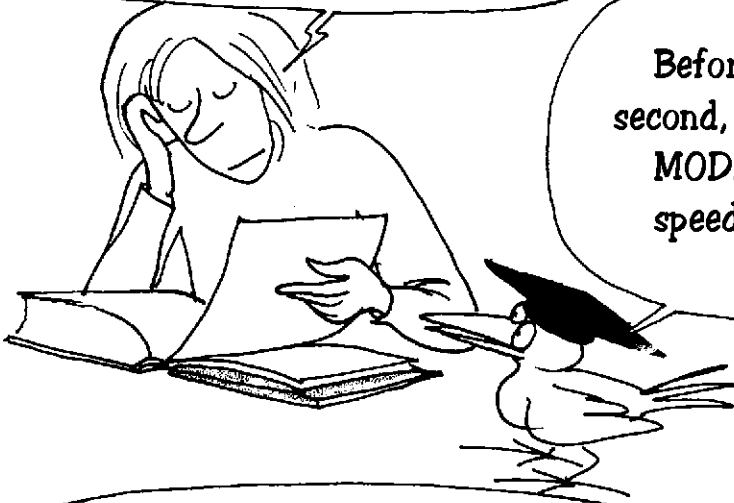
Maybe that's where the clue to the mystery is.

You just need to read the **BIG BOOK OF THE UNIVERSE** backwards and try to get to the first page.

You mean the preface, there where the author explains where he wants to get to?



The more we go back into the past,
the hotter the universe is, so the greater
particles' agitation speeds are (*)



Before the first hundredth of a
second, according to the **STANDARD**
MODEL, all particles moved at a
speed close to the speed of light.

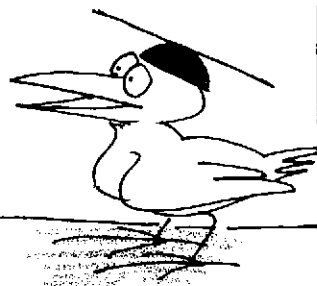


Tell me, according to the theory of
SPECIAL RELATIVITY when the speed
of light is approached, time is altered
isn't it? (**)



Time begins to "freeze" like
the mercury in thermometers

More precisely, a particle
moving at the speed of light
can go through an infinity of
events in a lapse of time... zero!



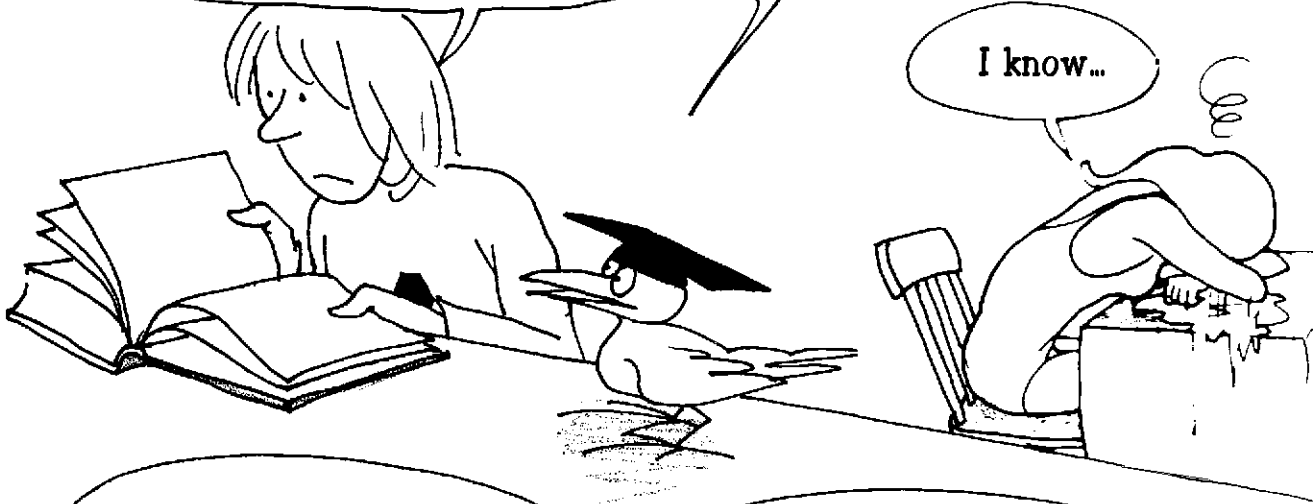
(*) The **TEMPERATURE** of a gas is nothing other than the measure of the
average thermic energy agitation $1/2 mV^2$. See "IF WE FLEW?".

(**) See "Everything is relative".

That's what I thought:
as I flick through this book to
get back to the **BEGINNING** its
pages get thinner and thinner.

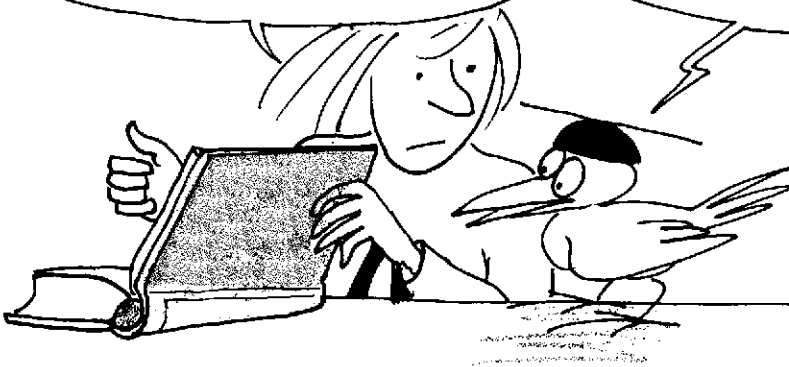
In fact an infinity of pages
need to be flicked through to get
to the start of the beginning

I know...



So what does this final
thickness of time of a hundredth
of a second that separates
us from $t = 0$ mean?

I think, in fact, it doesn't mean
much and it is more like a
simple **POINT OF VIEW**.



You mean it would be **PHYSICALLY** impossible to get back
to this **ORIGIN OF TIME** and, even more, get beyond it?

Yes, to cross it in this
spatiotemporal Sargasso sea
you would need a vehicle (and an
observer) made of ordinary matter.

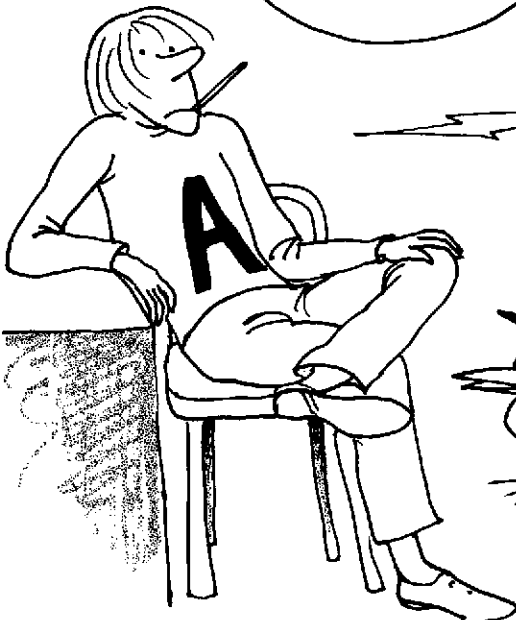
But around $t = 0$
everything moves
at the speed of light.



But...what is something that we imagined
but that we can't physically make?

I think the **BIG BANG**
is a scientific fantasy.

In short, according to
current models,
the universe was born in a
moment **WITHOUT SENSE**.
We don't know why it was
in such **CHAOS**, nor why
that state continued. As its
evolution happened in an
isentropic manner, the fact
that time passes remains a
complete mystery.

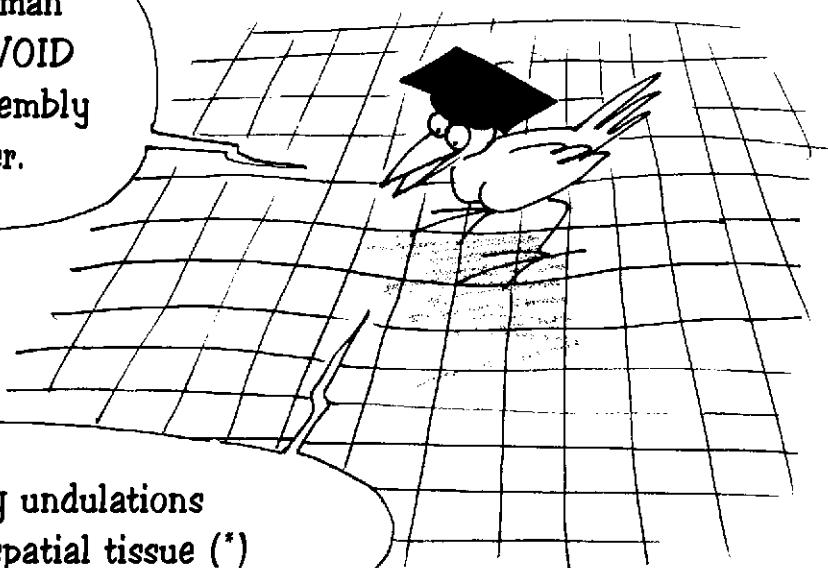


Back to the same...

THIRD COSMOLOGICAL PARADOX

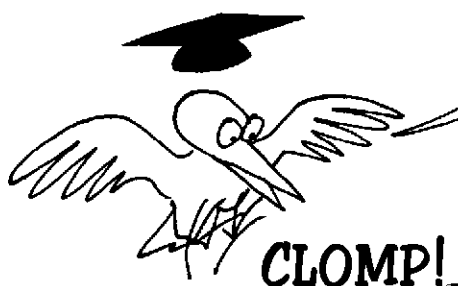


According to the Englishman
DIRAC what we call **THE VOID**
is in fact a very tight assembly
of matter and anti-matter.

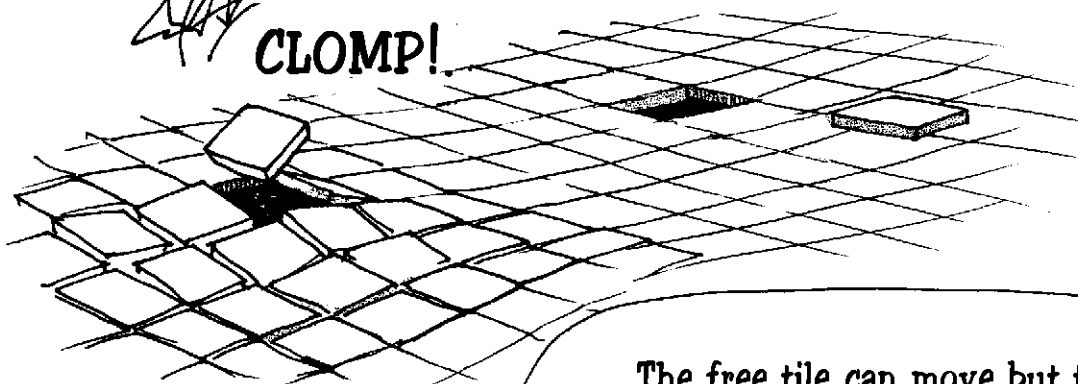


PHOTONS being undulations
that agitate this spatial tissue (*)

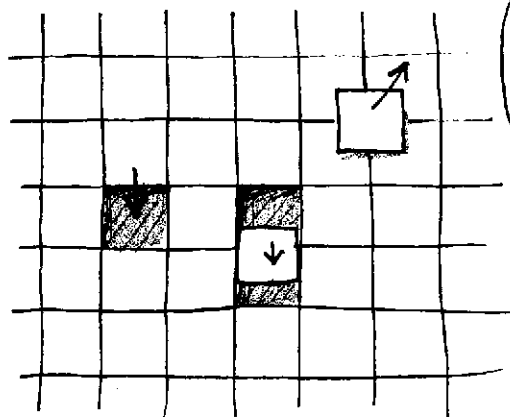
When two sufficiently pronounced undulations
meet, a tile comes unstuck. The freed tile
becoming synonymous with matter and the
void that it leaves with anti-matter



CLOMP!



The free tile can move but the hole
as well, because of the adjacent tiles,
like in the game of **MAGIC SQUARES**.

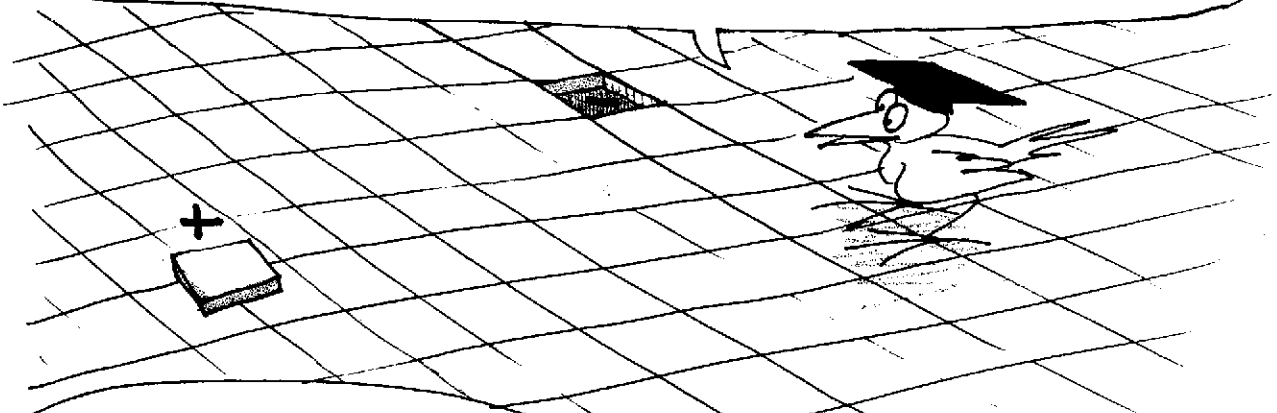


(*) See **BIG BANG**.

At the instant of the BIG BANG the turbulence of the cosmic tissue (the temperature) was considerable. The tiles couldn't stay in place. They came unstuck and joined each other incessantly in a fantastic hubbub.



When the temperature had diminished enough (*) almost all the tiles returned to free places... except one in a hundred thousand and the folds that were agitating the cosmic tissue became so weak that they were then unable to loosen any more tiles.

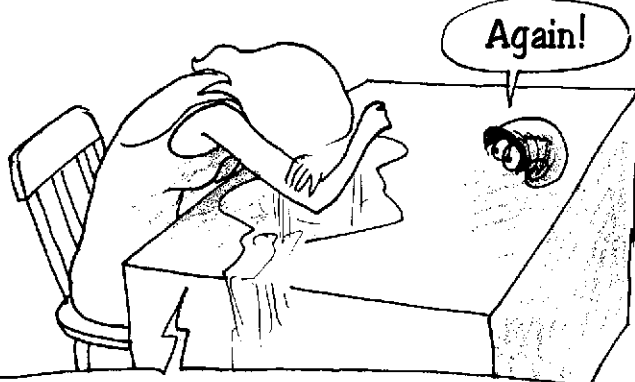


But the risk of complet annihilation remained important. As matter and anti-matter possess opposing electric charges, they were strongly attracted to each other.



(*) After 13 seconds the temperature of the universe had dropped to three hundred thousand degrees.

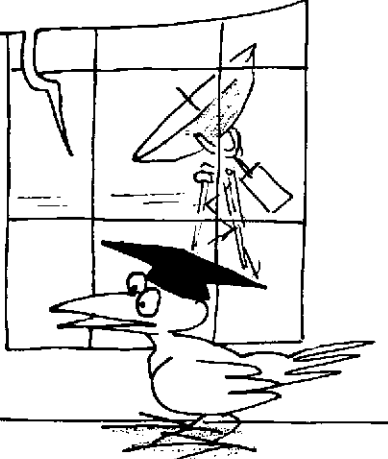
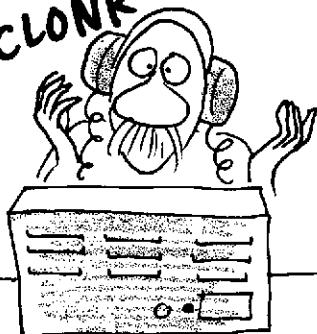
Well it's quite simple. Sophie said earlier, the brutal phenomenon of expansion separated these two enemy sisters and stopped their mutual destruction.



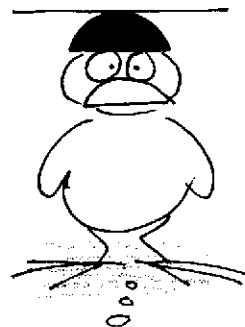
Yes, but in the meantime the Universe became collisional. If there were galaxies made of matter and others of anti-matter they would have met each other from time to time

And that would make radio noise so loud that it could be heard from one end of the Universe to the other

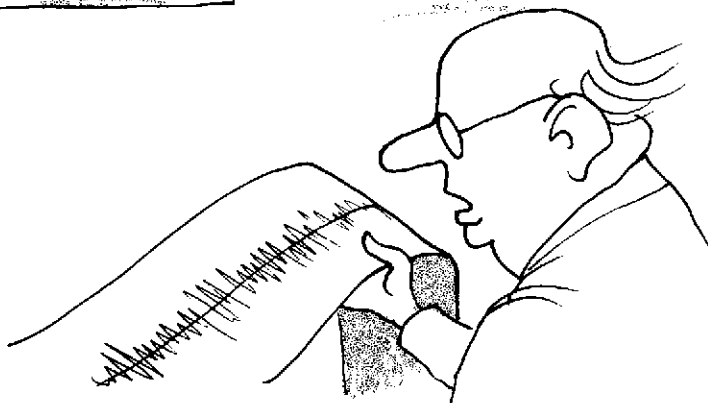
**CLONK CLONK
CLONK CLONK**



But we do not detect this matter - anti-matter annihilation



Worrying

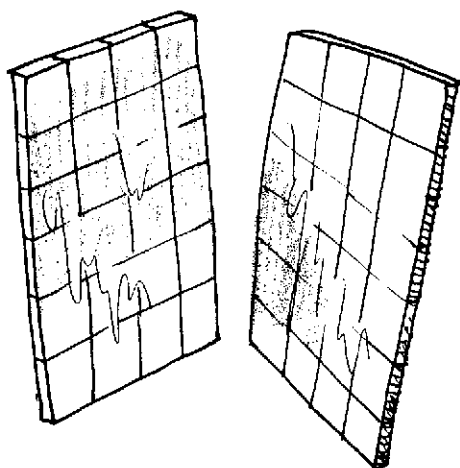


So if I understand it correctly, it's a miracle that we even exist.

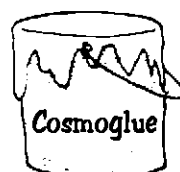
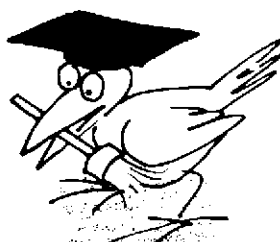
Tiresias, please, don't profit from the occasion.

Logically, if anti-matter isn't in our universe, it's somewhere else.

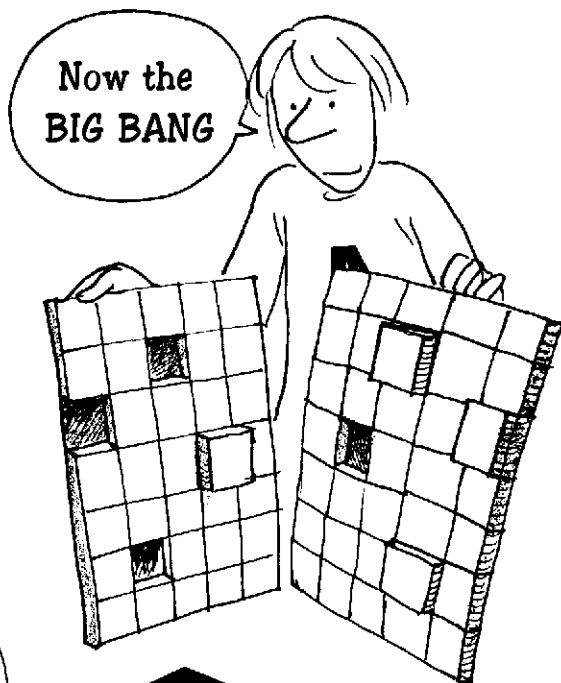
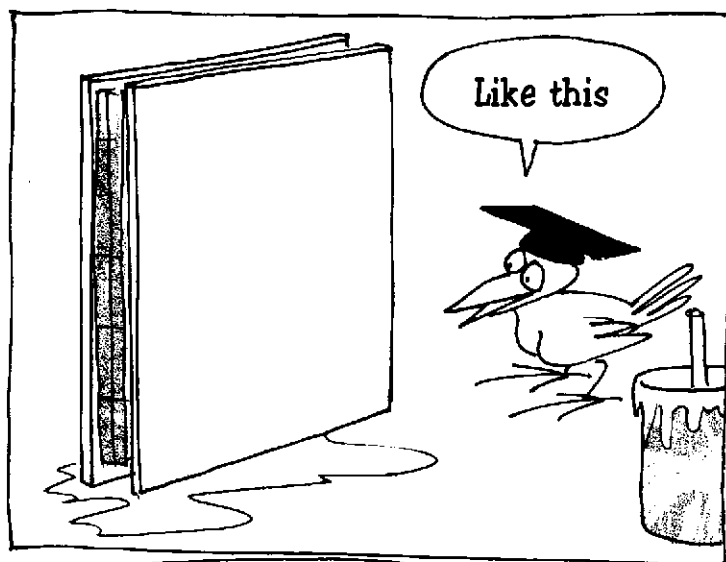
THEORY OF A. SAKHAROV and J.P. PETIT (*)



Let us suppose two united universes, joined together at the initial instant



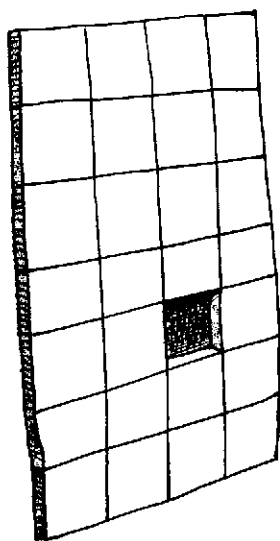
(*) J.P. PETIT: Enantiomorphic universes with their own opposed times in interaction with their image in the mirror of time. *Accounts of the Paris Academy of Science*, volume 284 (23 May 1977) series A, page 1315 and volume 284 (6 June 1977), page 1413. 46



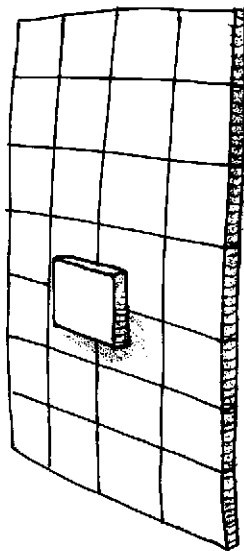
By separating these sheets it might be that on each paving certain tiles have been pulled off and others are extra-thick



In each of these universes the extra-thick tiles will lodge in the free areas. If the situation is perfectly symmetrical we'd find the initial flatness again.

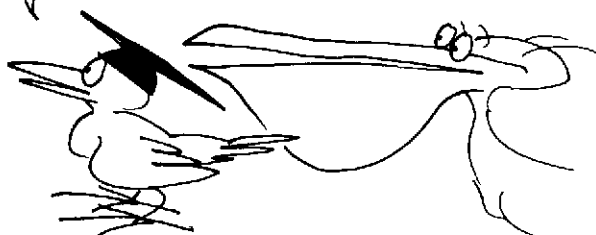


ANTI-UNIVERSE
(anti-matter)

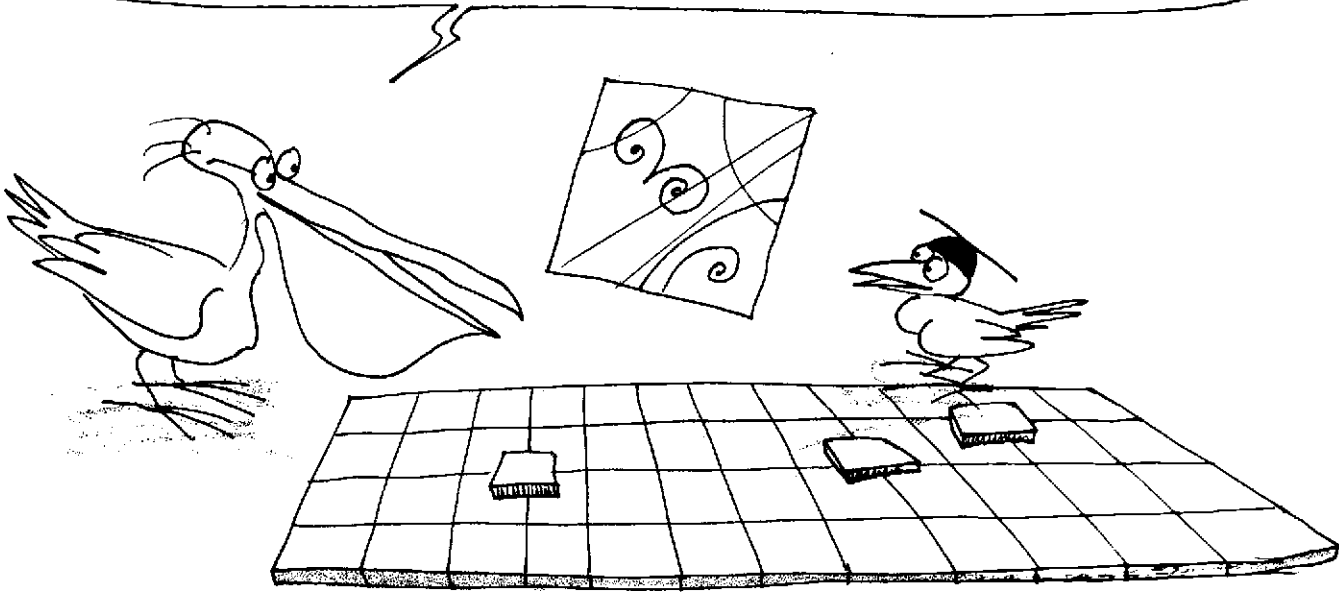


UNIVERSE
(matter)

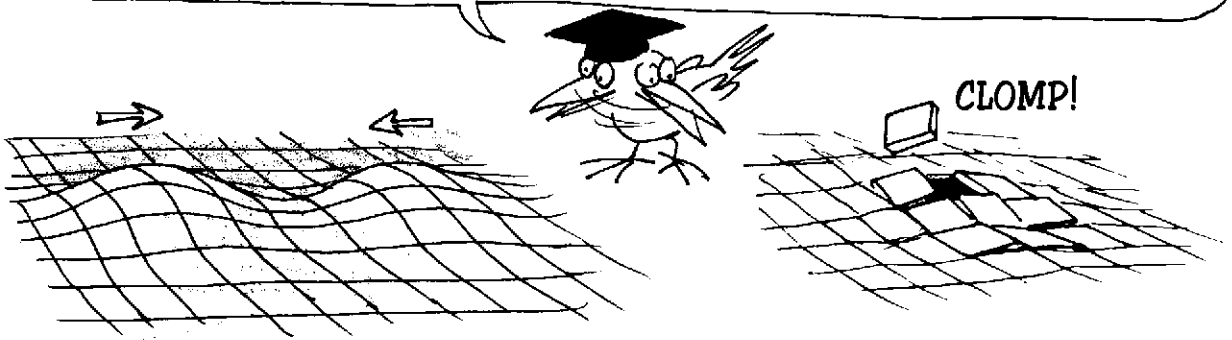
However, if a **SYMMETRY BREAK** occurs, there will be an excess of matter in one of these universes and an excess of anti-matter in the other, which could no longer annihilate each other.



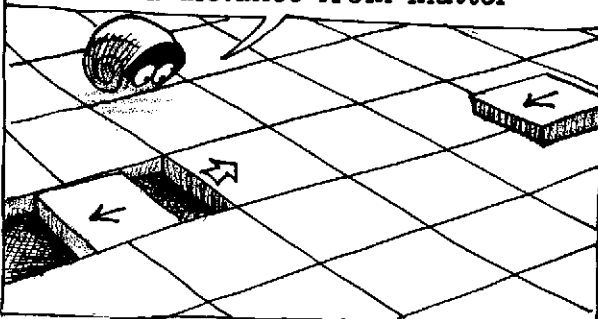
But...to what does the anti-matter discovered in cosmic rays, a little while after Dirac's discovery, correspond, or that that's created in laboratories?



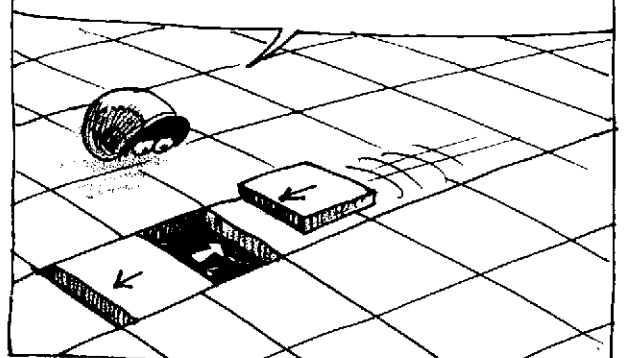
Down here there is nothing to stop us from creating strong energy concentrations in giant particle accelerators, to the point of detaching another tile, that is to say the creation of a matter-anti-matter PAIR.



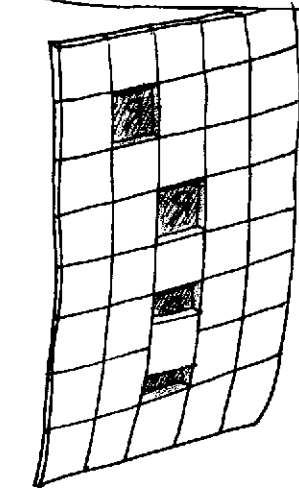
But if you don't take precautions to keep this anti-matter at a distance from matter



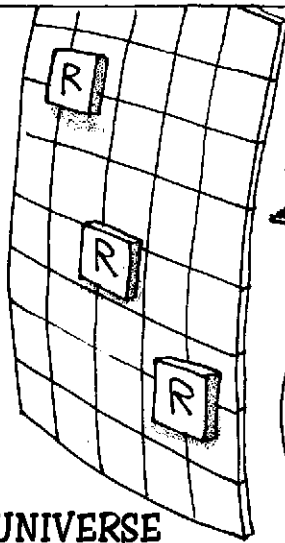
it will immediately annihilate itself.



Andrei Sakharov used this twin vision to explain the apparent absence of anti-matter on our "side" of the Universe



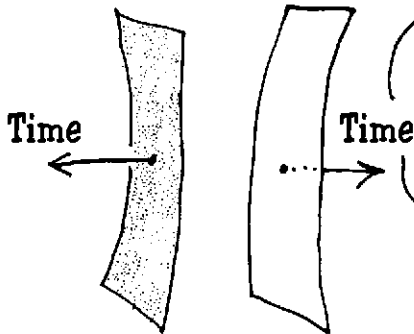
ANTI-UNIVERSE



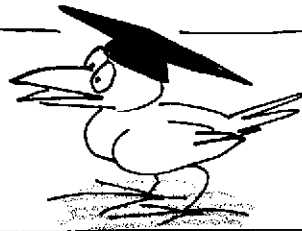
UNIVERSE



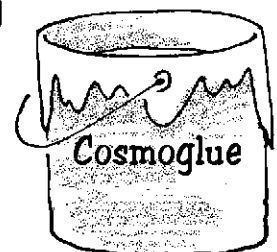
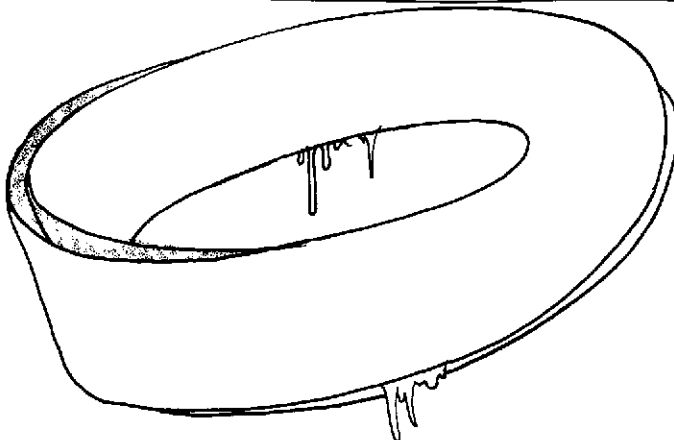
The two TWIN UNIVERSES present inverted PARITIES (broken RIGHT-LEFT symmetry)

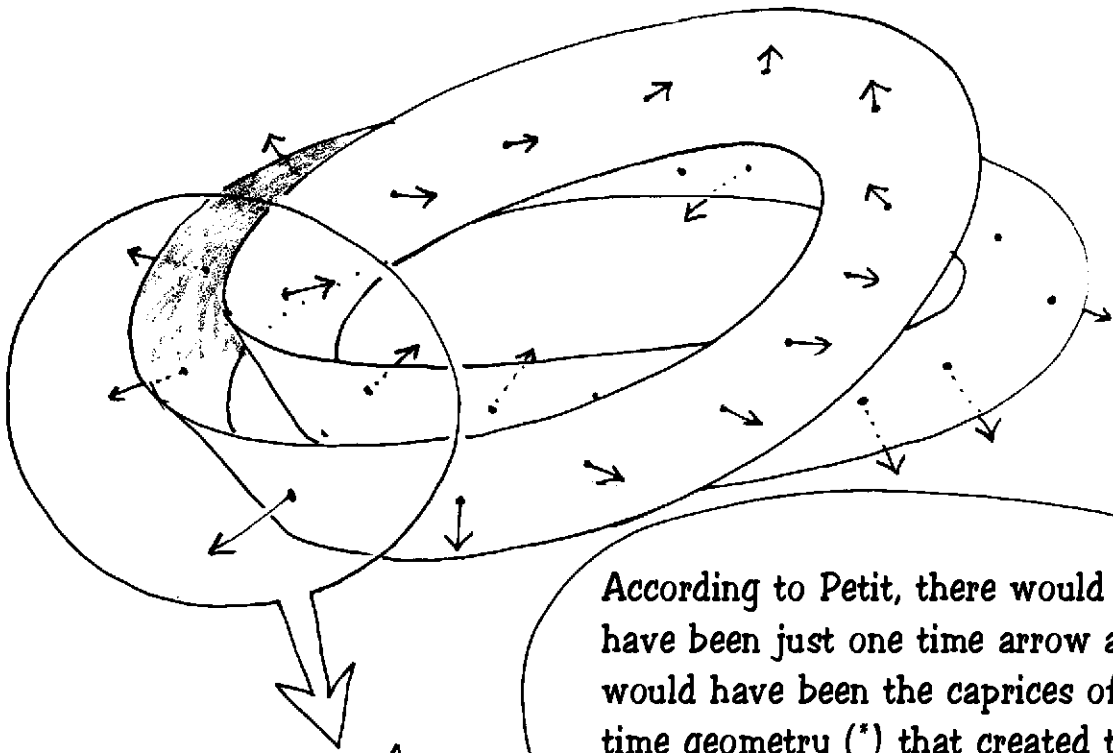


The TIME ARROWS will also be in opposition, the future of one universe being the past of the other.

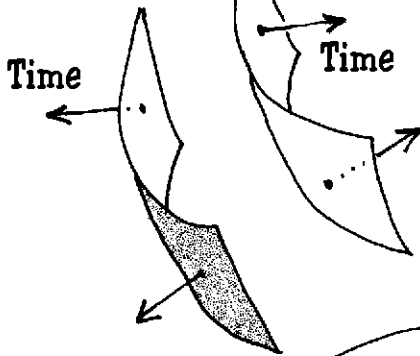


The same approach was effected independently by Jean-Pierre Petit in 1977, he believes that there was just one universe, initially attached to itself along a "three dimensional Moebius strip"

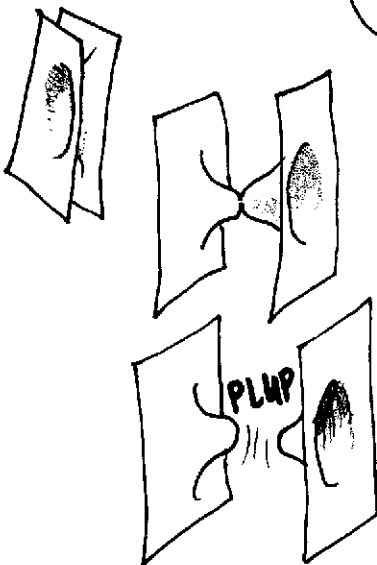




According to Petit, there would then have been just one time arrow and it would have been the caprices of space-time geometry (*) that created this **TWIN STRUCTURE** illusion



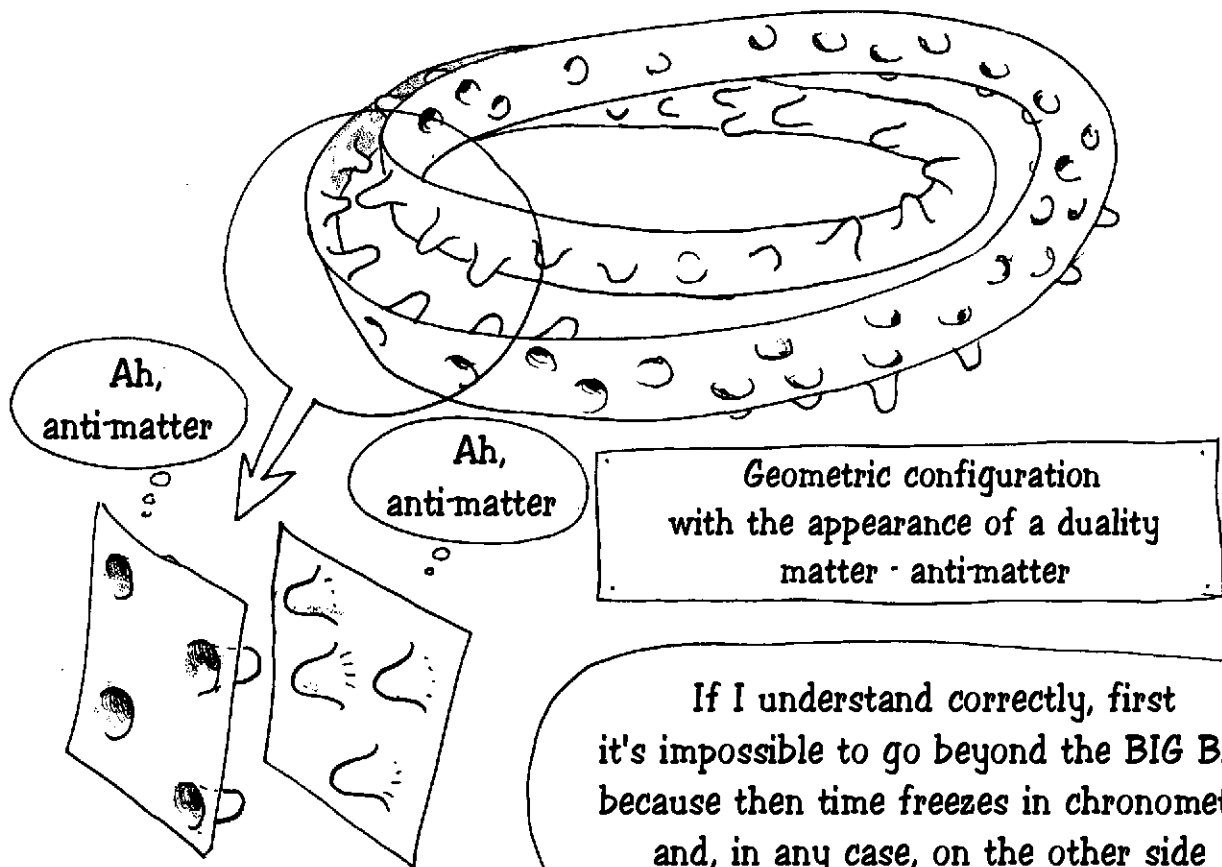
There would also have been just one sort of matter, anti-matter being, according to the term of Abbé Lemaître, "seen backwards"



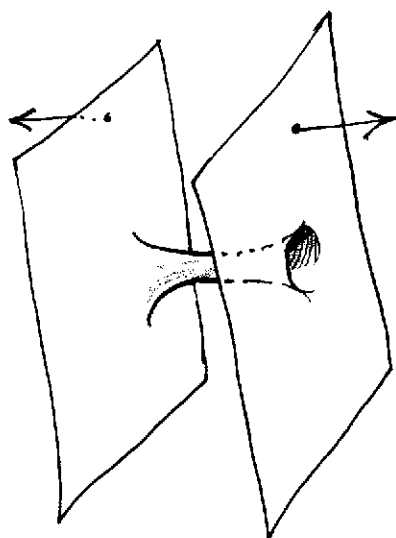
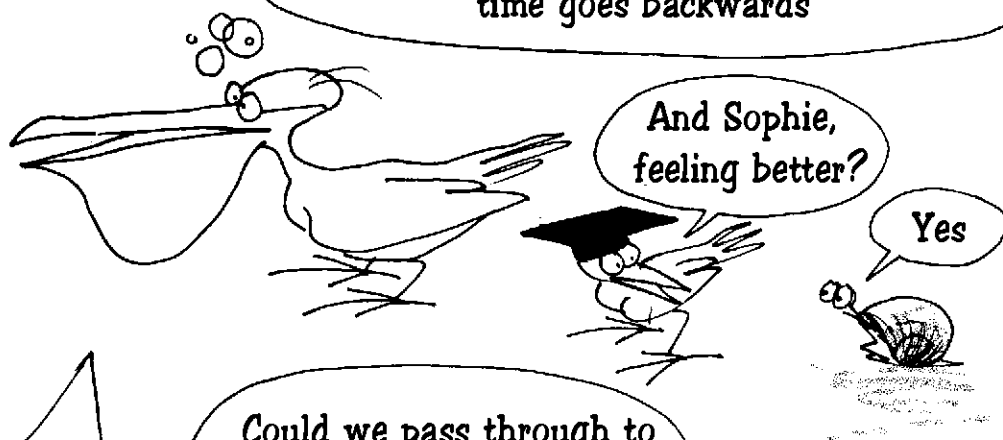
These would have been residual curvature deformations



(*) See TOPO THE WORLD.



If I understand correctly, first it's impossible to go beyond the **BIG BANG** because then time freezes in chronometers and, in any case, on the other side time goes backwards



Could we pass through to the other side with the help of black holes and find ourselves among the **RETROCHRONIANS**?

Gosh!...



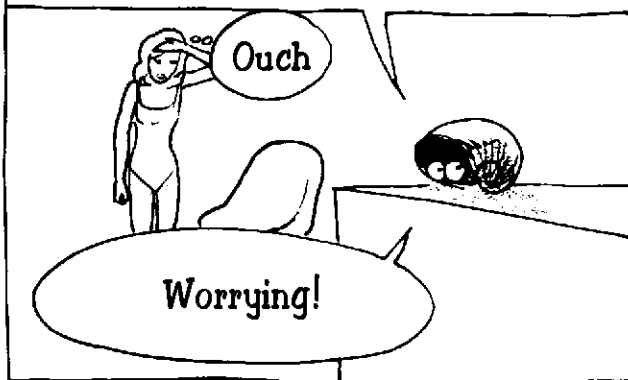
DIACHRONIC AND RETROCHRONIC

If we met retrochronians one day what should we say to them?



"Goodbye" I expect, because in their OWN TIME they are leaving.

Now that's an odd conversation. They'll know everything we were going to say but have no idea of phrases we'd said before.



It'll be interesting economically though, they'd be interested in our waste which they could change into raw materials.



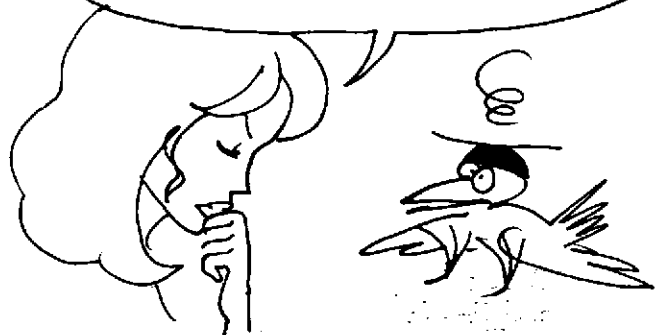
Archibald was asking how we could exchange messages with retrochronians.



Excuse me, I've lost the thread...where were we?



That seems difficult to me because if we sent them a message, when they received it, in their time, they would be sending it.



So with these people all dialogue would be impossible?



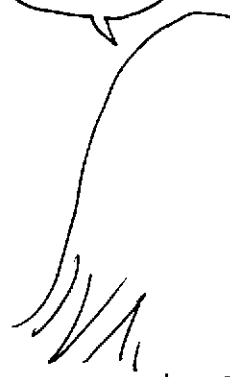
Or a person exists with whom we could never exchange information.



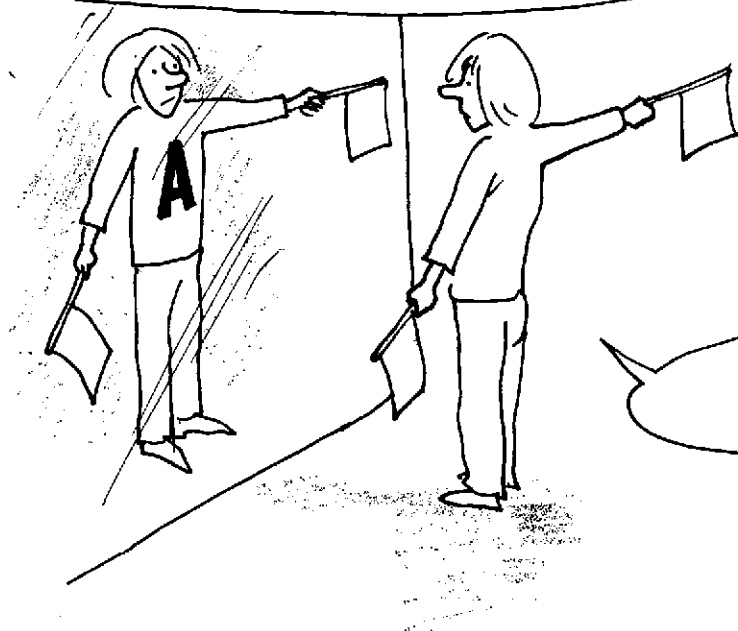
Yourself.



!!!



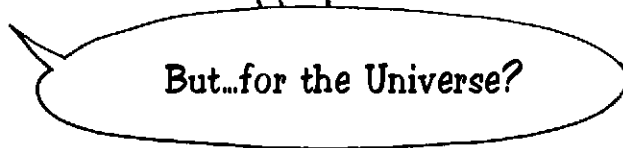
Try sending yourself a message through the mirror.



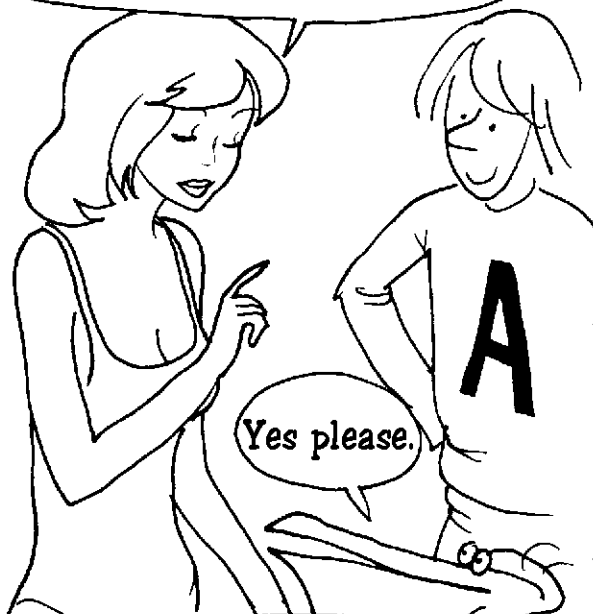
You won't learn much.



But...for the Universe?

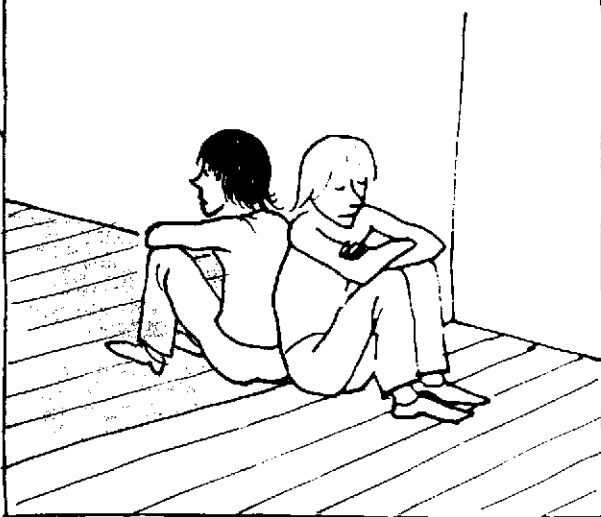


You like stories.
I'll tell you one.

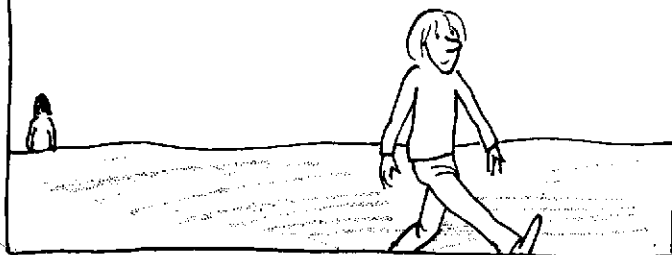


Yes please.

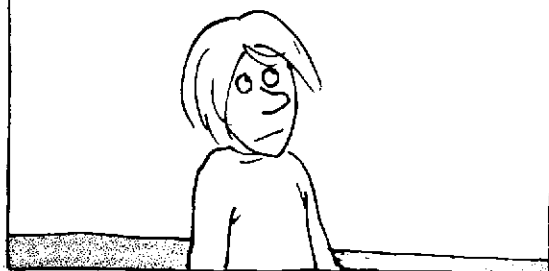
Once upon a time there were two
young boys who spent their days
pressed back to back, like bookends.



They lived in the same house and on
the same landing. One day they went
straight out from where they lived,
the brown haired one to the west,
the blond to the east.



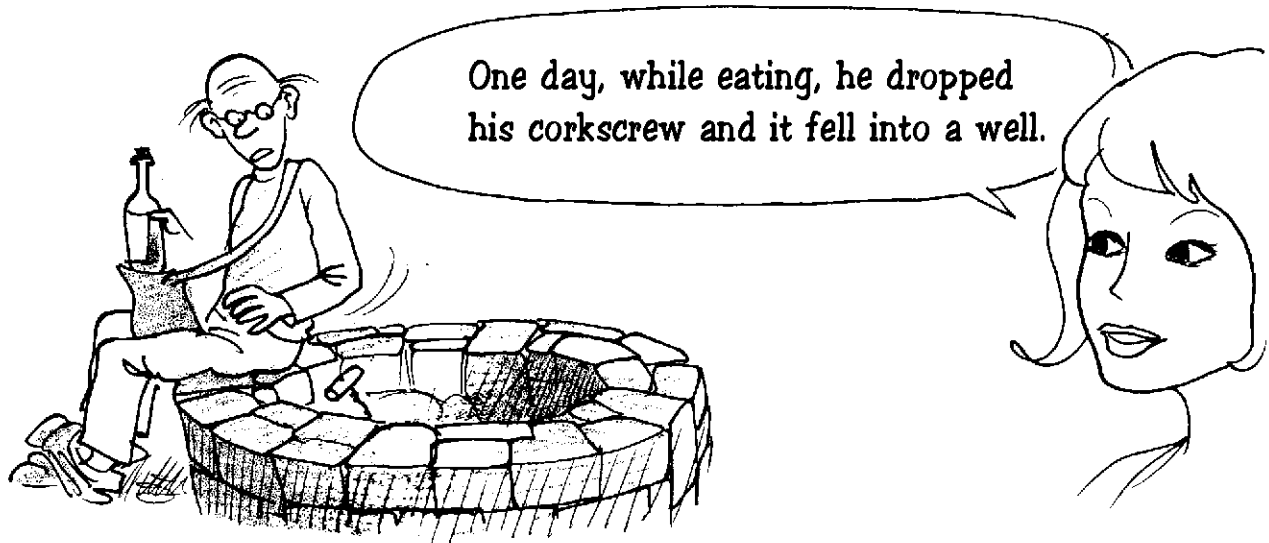
The blond said "if the world is
round, by walking straight we
should go right round and
meet each other half way".



The journey was unimaginably long and the blond
thought he wouldn't live long enough to get to the end.



It's amazing how my sight is going
and I've lost almost all my hair.



When he was halfway, at the other side of the world, it was very cold and he suffered because he had lost all his hair. He waited for his companion in vain.

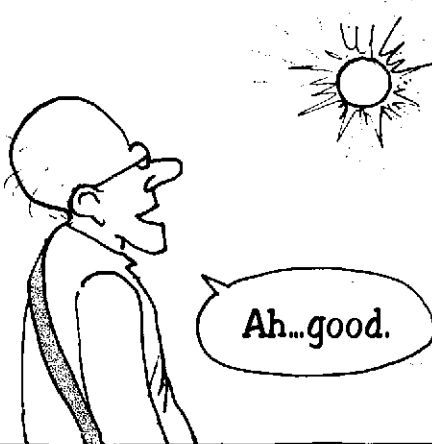


Saddened, he began the journey home

All that way for NOTHING.

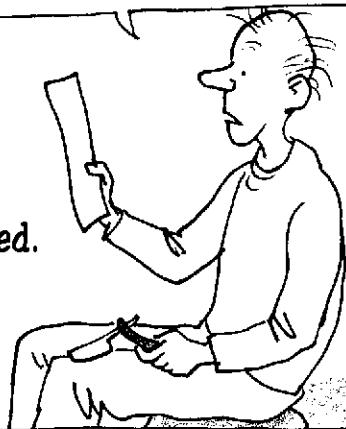


But things began to improve. The sun began to shine.



Incredible! My hair is growing again and I hardly need glasses anymore!

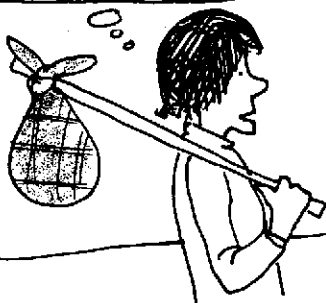
Time passed.



The loss of his corkscrew bothered him but one day while eating by the side of a well, a corkscrew popped out.



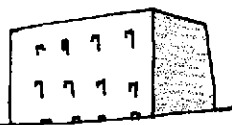
The circle was completed.



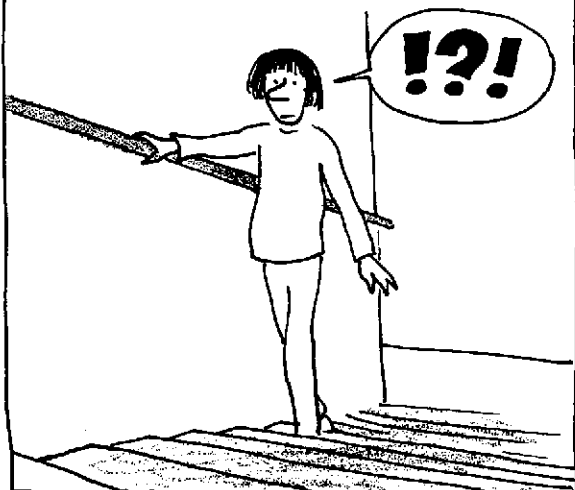
However, despite his efforts, he couldn't use it.



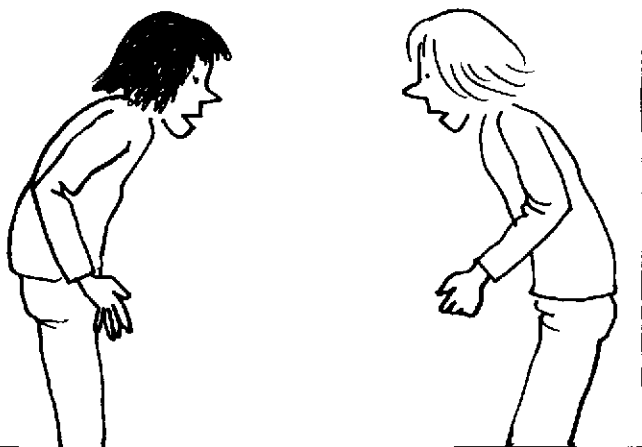
Finally, in the distance, he saw the building he had left so long ago.



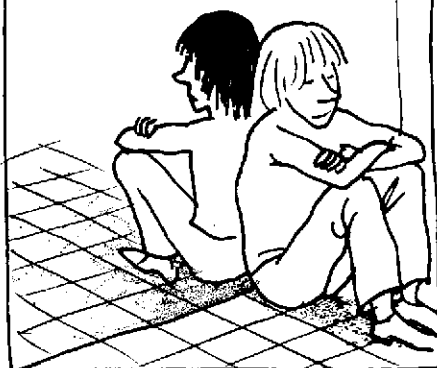
He climbed the stairs and came face to face...



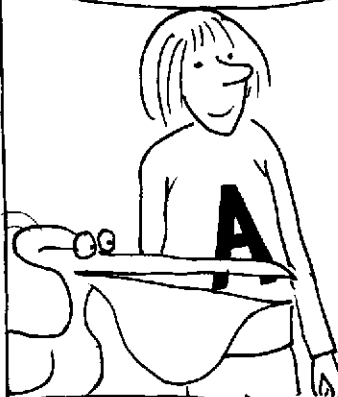
...with a young, blond boy...



So they sat down back to back as before.



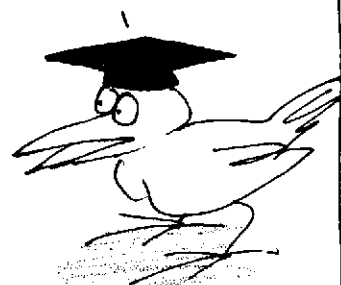
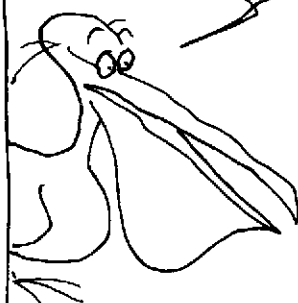
And that's the end of my story.



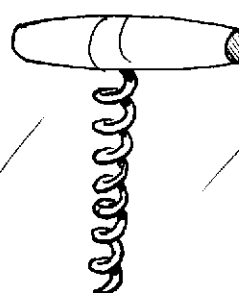
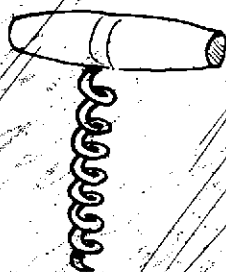
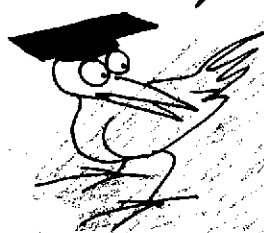
I think I've understood.
They aren't really back to
back, it's a sort of mirror,
a SPATIO-TEMPORAL mirror.



But the bit about
the corkscrew... and the wells?

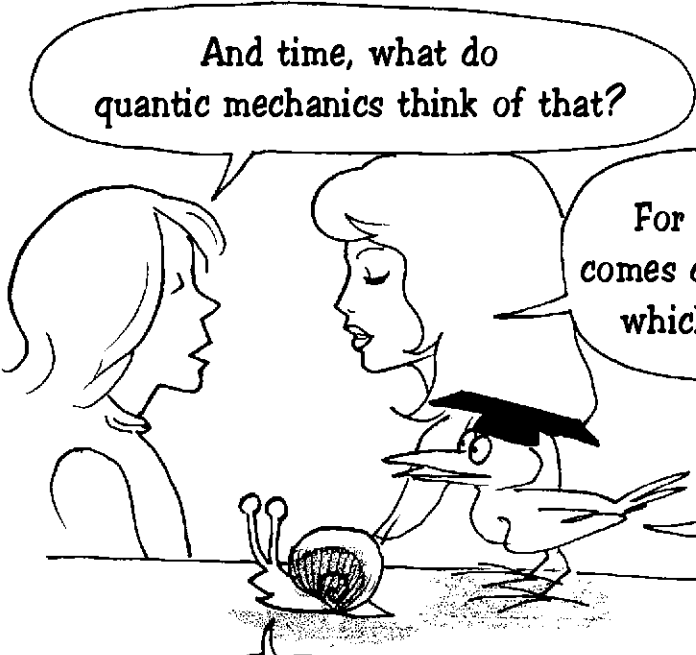


I think the first well was a **BLACK HOLE** and the other a **WHITE FOUNTAIN**. I think that if he couldn't open the bottle it was because the corkscrew had become **ENANTIOMORPHIC**, mirror-like.



(*) See The Black Hole, page 61.

TIME AND QUANTUM MECHANICS




And time, what do
quantic mechanics think of that?

For quanta physicists the Universe
comes down to SCHRÖDINGER'S equation,
which uses the PLANCK CONSTANT h .

All the EVENTS of the Universe
are supposed to be solutions
to this master equation.

Ah, at least one theory that answers everything.



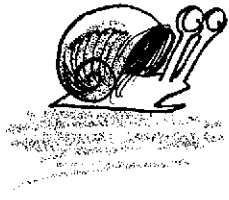
A characteristic time t_p , PLANCK'S TIME (*),
equal to $0.53 \cdot 10^{-43}$ seconds is associated with
this equation. It is fundamentally impossible,
using Schrödinger's equation, to describe a
phenomenon with a duration of less than
Planck's time t_p .



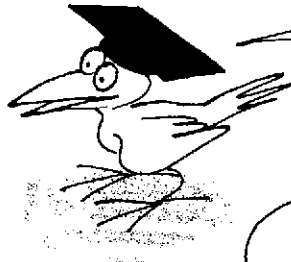
That's something else...

(*) See Annex D.

That would mean that the present has a finite thickness.

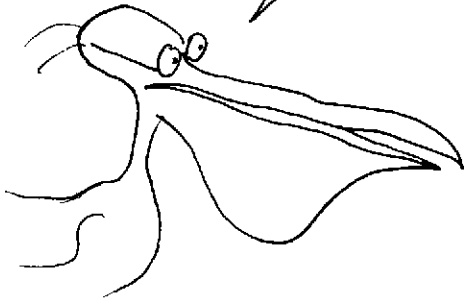


It also means that for quanticians the past stops at 10^{-43} sec. They are also unable to conceptually reach the time $t = 0$.



Really...

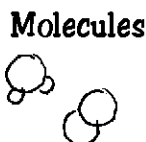
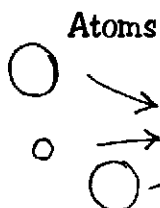
So what are we talking about exactly? If the Universe is a machine what are its main mechanisms?



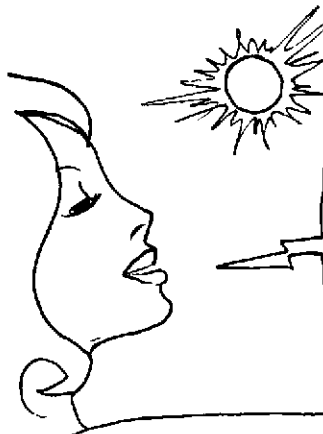
Schematically the known Universe is a mix of photons and particles of matter, in a ratio of a thousand million to one. Gravity creates assemblies of matter where FUSION continually converts matter into radiation. The products of these reactions are called "atoms" (*).



These products of NUCLEOSYNTHESIS can interact, either spontaneously or by reabsorbing photons (PHOTOSYNTHESIS), producing assemblies called molecules. Atoms can also decompose by re-emitting photons (NUCLEAR FISSION).

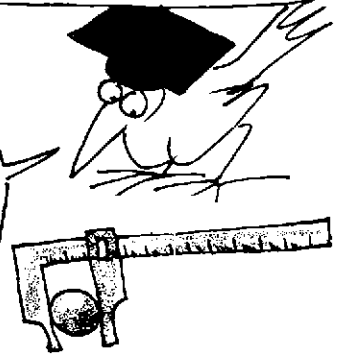


(*) See A Thousand Million Suns.



Matter and light are two manifestations of one and the same entity. **ENERGY-MATTER** and all these phenomena just translate as a slow reversion of a part of matter in the form of photons.

At the beginning of the century it was supposed that particles of matter kept an invariable size, that is to say that the energy-matter they contained was conserved with time.

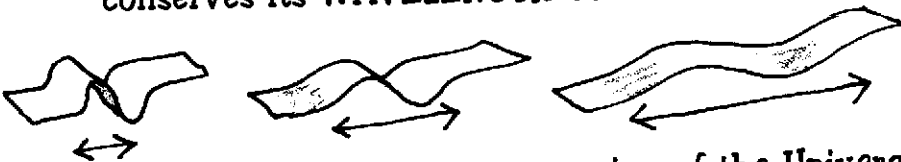


What is the magic link between an object's size and its energy?

As you know in quantum mechanics all particles are considered to be undulations of space, to **WAVE PACKETS**. By definition if E is the quantity of energy-matter carried by a particle, the associated wavelength is $\lambda = hc/E$ (*)

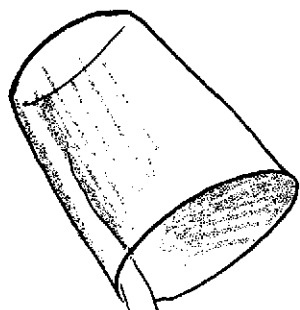


The wave packet that a particle of **MATTER** represents conserves its **WAVELENGTH** over time.



A **PHOTON** follows the expansion of the Universe.

(*) h : Planck's constant
 c : Speed of light

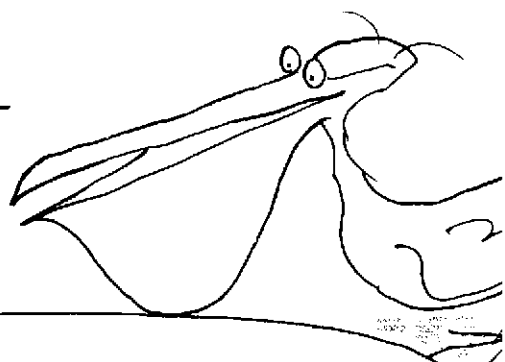


The two forms of **ENERGY- MATTER**, matter and photons, don't experience cosmic expansion in the same way.



Ah yes, matter is **FROZEN** energy - matter (*)

In short, the Universe is made up of grains of matter and photons with a lot of **EMPTINESS** around them.



No, no Leon, **EMPTINESS**, the void, doesn't exist. In quantum mechanics the Universe is a surface that isn't "**SMOOTH**" anywhere. Certain folds are as if starched and represent matter. Other folds, photons, can stretch and that's what allows the Universe to expand.

But... wait... If energy varies as the inverse of the wavelength, the spatial extension of a particle, then this photon distension translates as a **CONTINUOUS LOSS OF ENERGY** by the Universe.

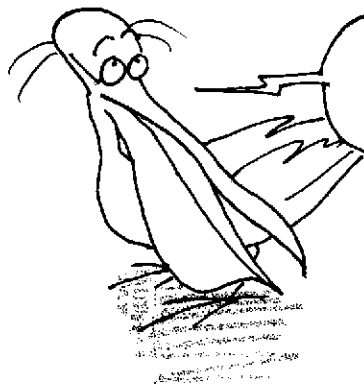


And obviously no one gives a fig.

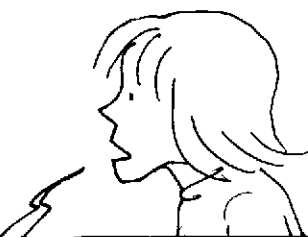


(*) See **BIG BANG**.

COSMIC EXPANSION



Instead of having a Universe with a constant entropy and with variable energy, it would be better to have the opposite. Well...



If I understand it correctly, the **EXPANSION OF THE UNIVERSE** goes hand in hand with the growth of the space occupied by the original photons, which constitute the **BACKGROUND COSMOLOGICAL RADIATION**. Under these conditions the universe should dilate **EVERYWHERE**.

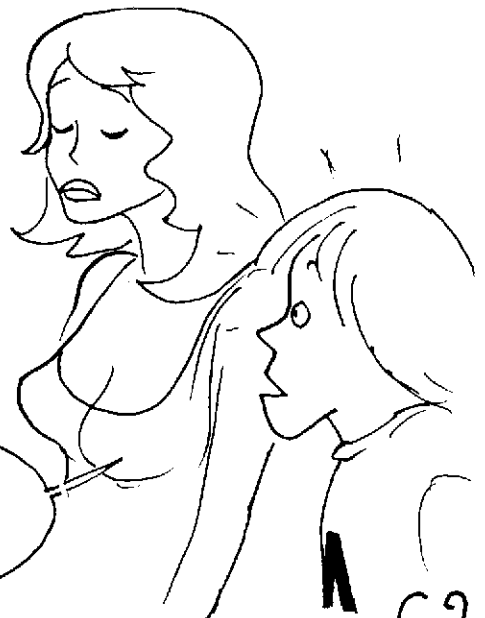


However according to the astrophysicists neither the solar system nor the galaxies, nor the clusters of galaxies dilate. So **WHO PAYS THE PRICE FOR EXPANSION?!**

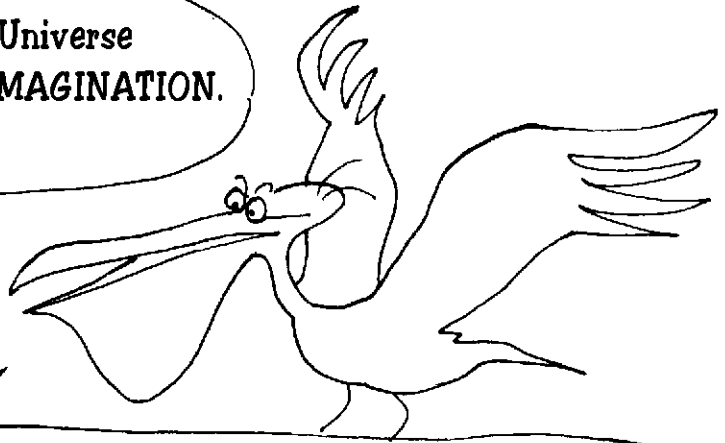
Well Sophie?

Erm...

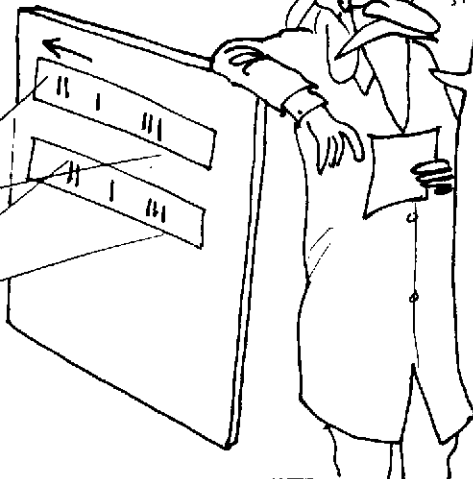
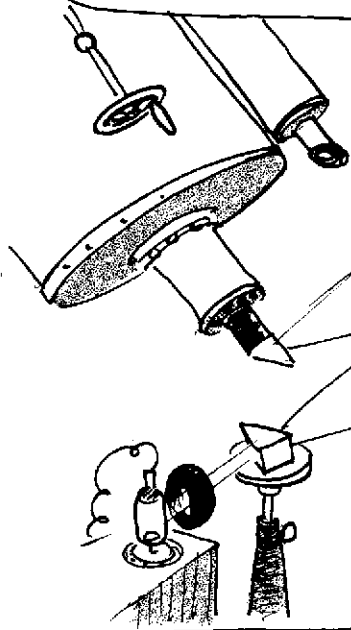
Tell me, is theoretical cosmology really serious?



After all, maybe the Universe
is just the fruit of our IMAGINATION.



Come on, Tiresias, don't be silly. What do you do with
EXPERIMENTAL FACTS, OBSERVATIONS?!? If we believe in
cosmic expansion it's because of the **RED SHIFT**.



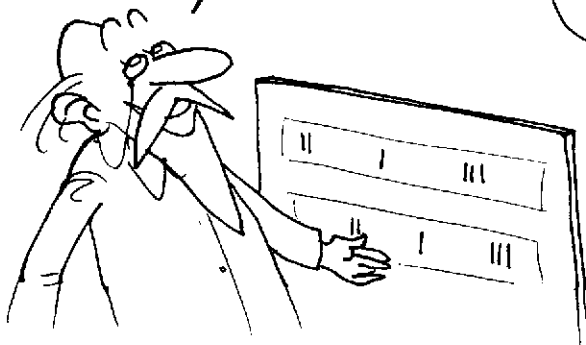
Look at these two spectra.
One is produced by hydrogen
heated to a high temperature,
the other is of decomposed
light sent by a distant galaxy
and shows an important shift
towards red. From this
DATA we deduce the
RECESSION SPEED. Where's
the imagination in that?

How can you be sure that this red shift
is due to the **DOPPLER-FIZEAU** effect?



What do you want it to be due
to? That the light got tired?...

The cosmologist and philosopher **MILNE**,
who refused the idea of the expansion of
the Universe, gave a completely different
signification for this photon frequency
reduction .



A photon's energy is $h\nu$, where h is Planck's constant and ν the frequency. MILNE said "Let us suppose that a photon's energy is conserved but that h increases proportionally to time. Then, at the reception of the message, we would measure a lower frequency ν , without a DOPPLER effect, without expansion".

A **STATIC** universe!
My friend that doesn't work.
What do you do with fossil
radiation, the trace of
PRIMORDIAL EXPANSION?

OK, let's go back to an expanding universe,
but expanding in relation to **WHAT**?

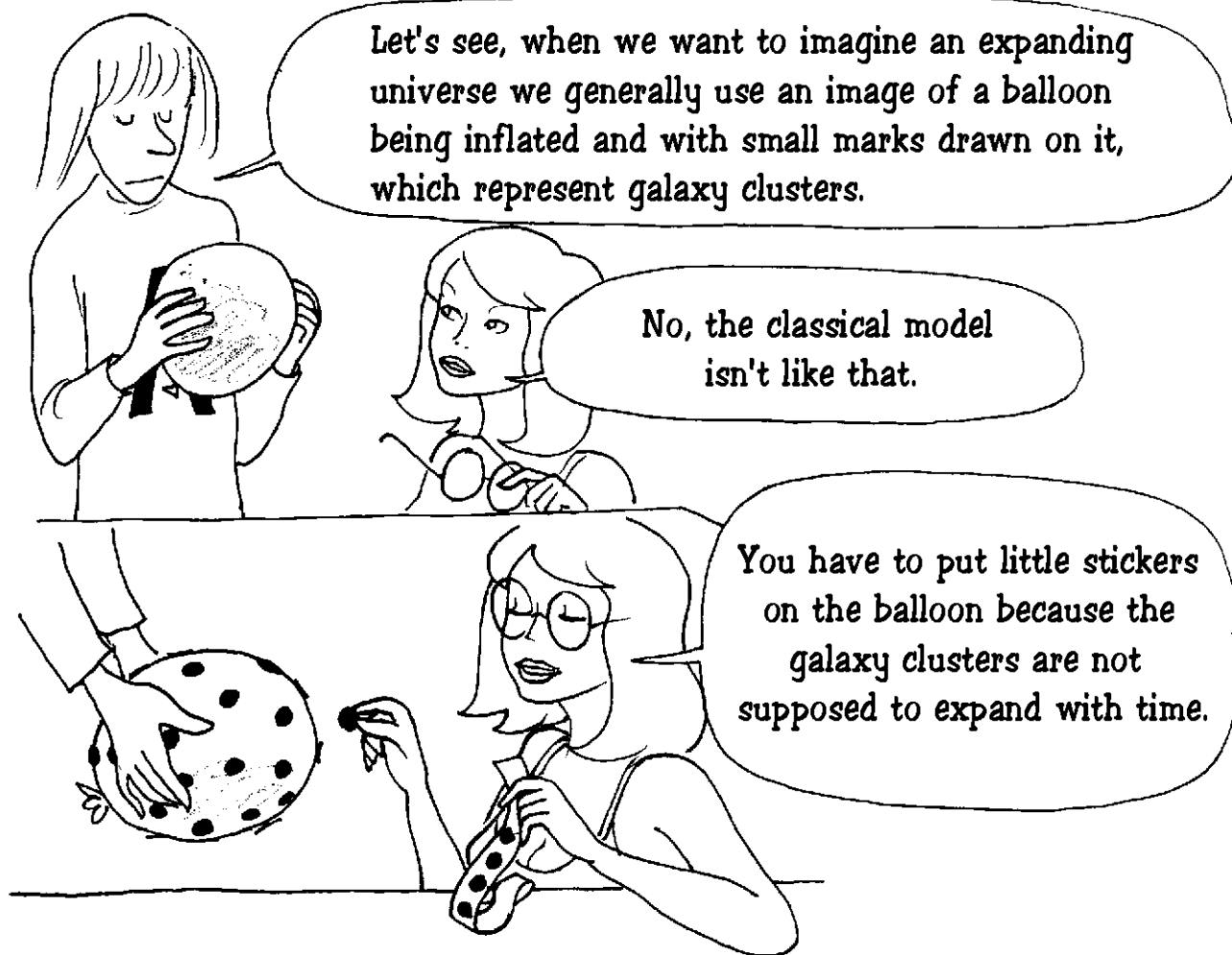
Is there a **COSMOTOPE**? (*)

A nonsense! The container and the content
of the Universe are one and the same object.
The only thing that counts is the measure of the shift

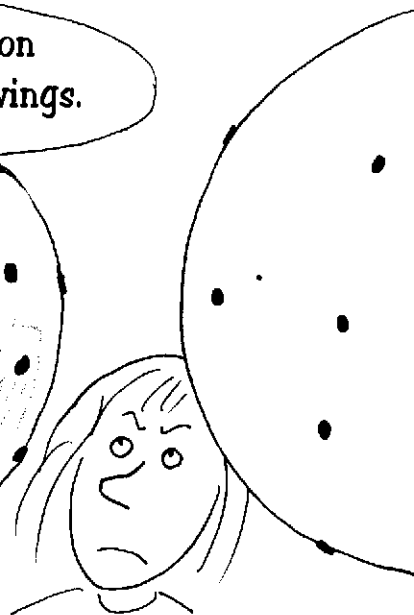
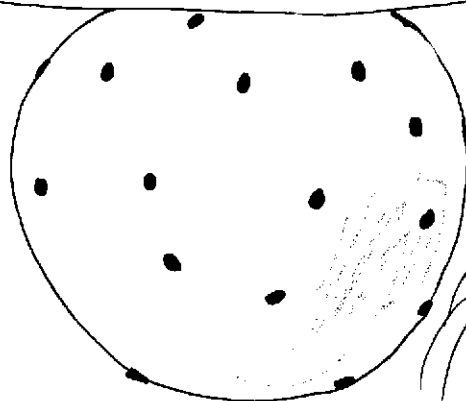
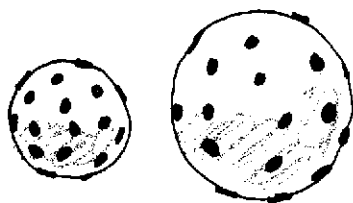
In any case we can't go and measure in-situ things that
are millions of light years away. We have to build a
SYSTEM OF REPRESENTATIONS that will account for
observations in an acceptable way. In Science we never
do anything other than to **KEEP UP APPEARANCES**.

(*) Literally: "the place where the universe is".

YELLOW MODEL (*)

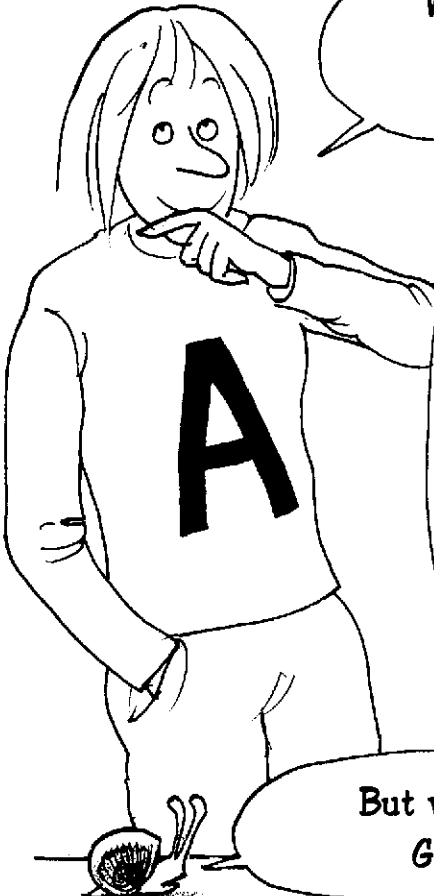


In this case the cosmic expansion corresponds to the following drawings.



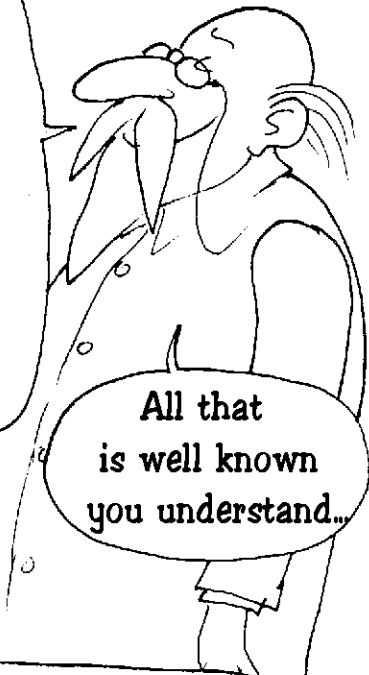
(*) "An interpretation of cosmological model with variable light velocity": JP Petit, Modern Physics letters A, Vol. 3, N° 16 (1988) Page 1527-1532.

"Cosmological model with variable light velocity, the interpretation of red shifts": JP Petit, Modern Physics letters A, Vol. 3, N° 18 (1988), page 1733-1744.




Why don't all the objects in the Universe increase in size at the same time as the Universe does: galaxies, the solar system, elementary particles?

My young friend, the size of objects is determined by a certain number of constants: the gravity constant G , Planck's constant h , the mass of the proton m , the speed of light C .



All that is well known you understand...

But why are these quantities G , h , m , C invariables?



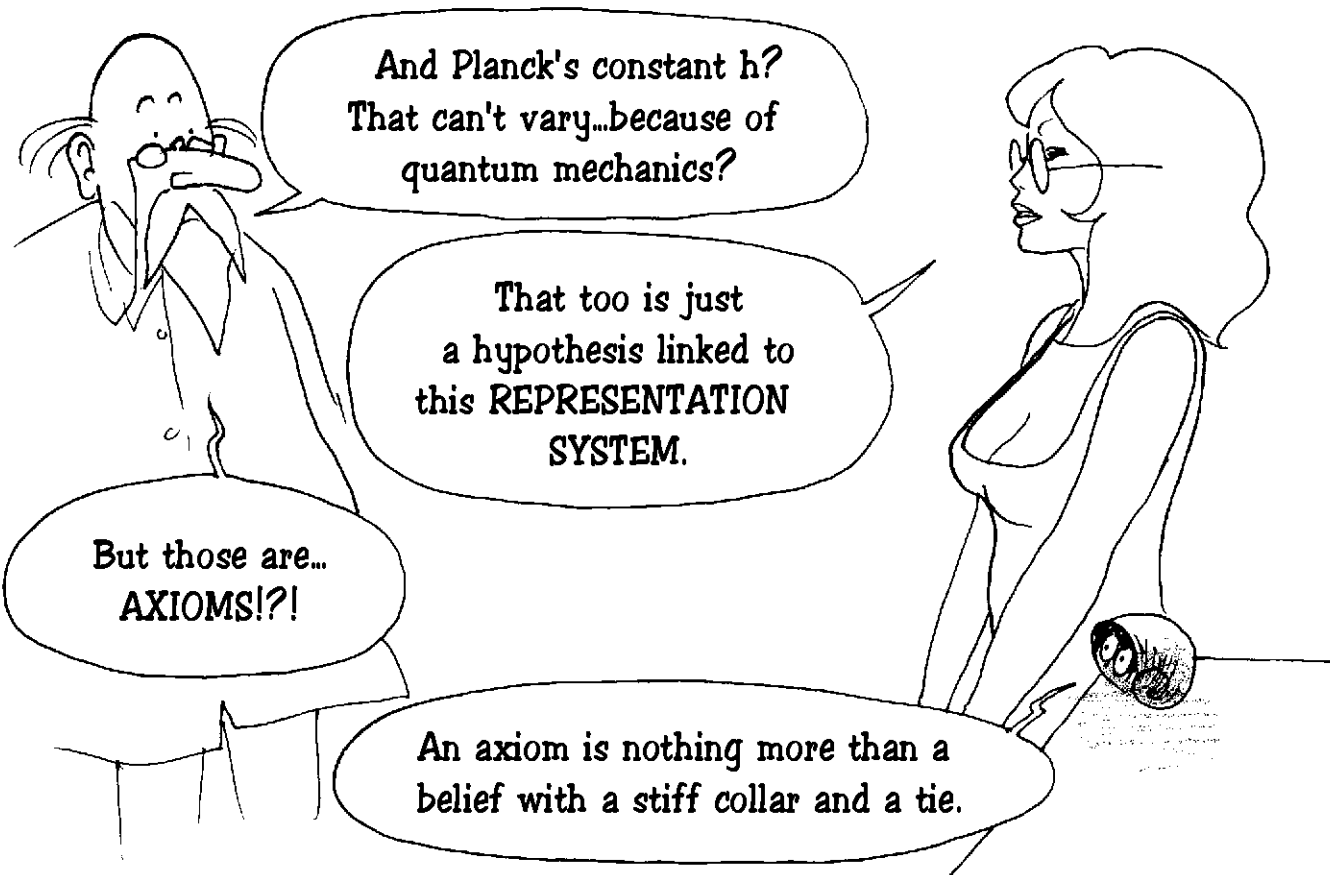
Well because they don't vary...

From one day to another, from one end of the Earth to the other, of course, but why haven't these sizes varied for thousands of millions of years?

I suppose that the speed of light C must be constant because of General Relativity...

That isn't written anywhere...

No?...



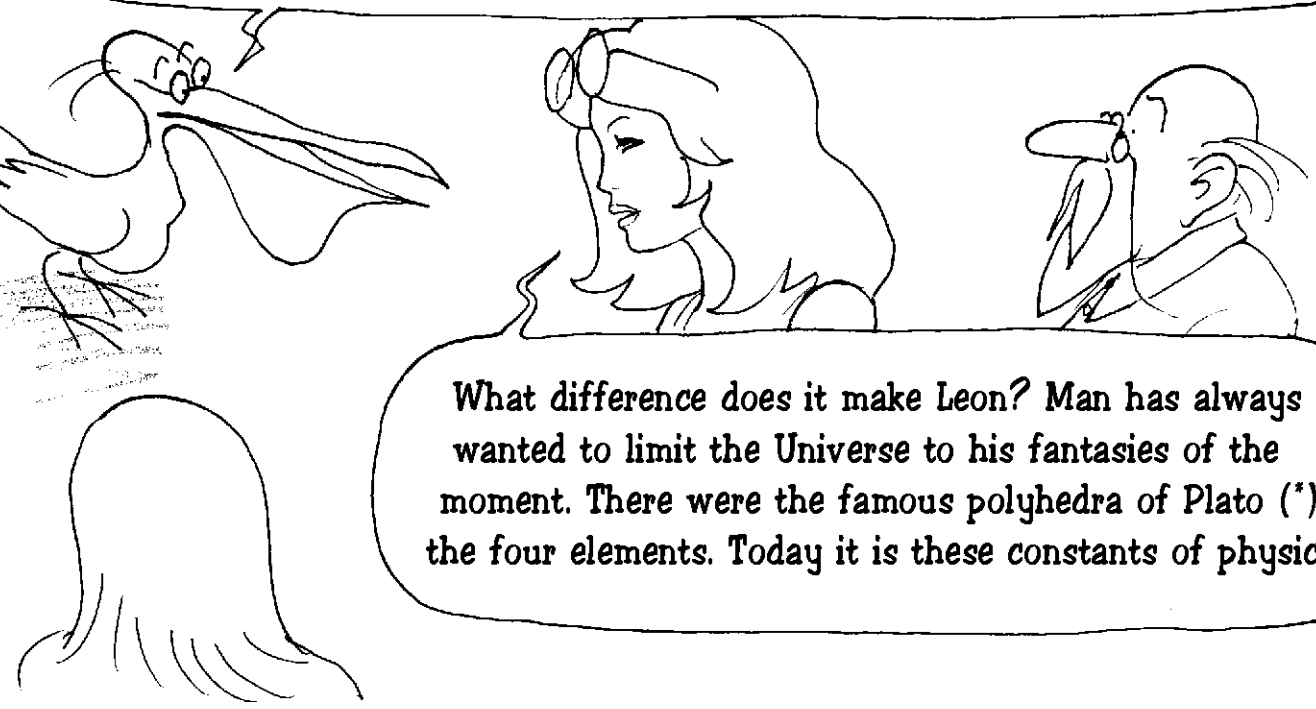
And Planck's constant h ?
That can't vary...because of
quantum mechanics?

That too is just
a hypothesis linked to
this **REPRESENTATION**
SYSTEM.

But those are...
AXIOMS!?!

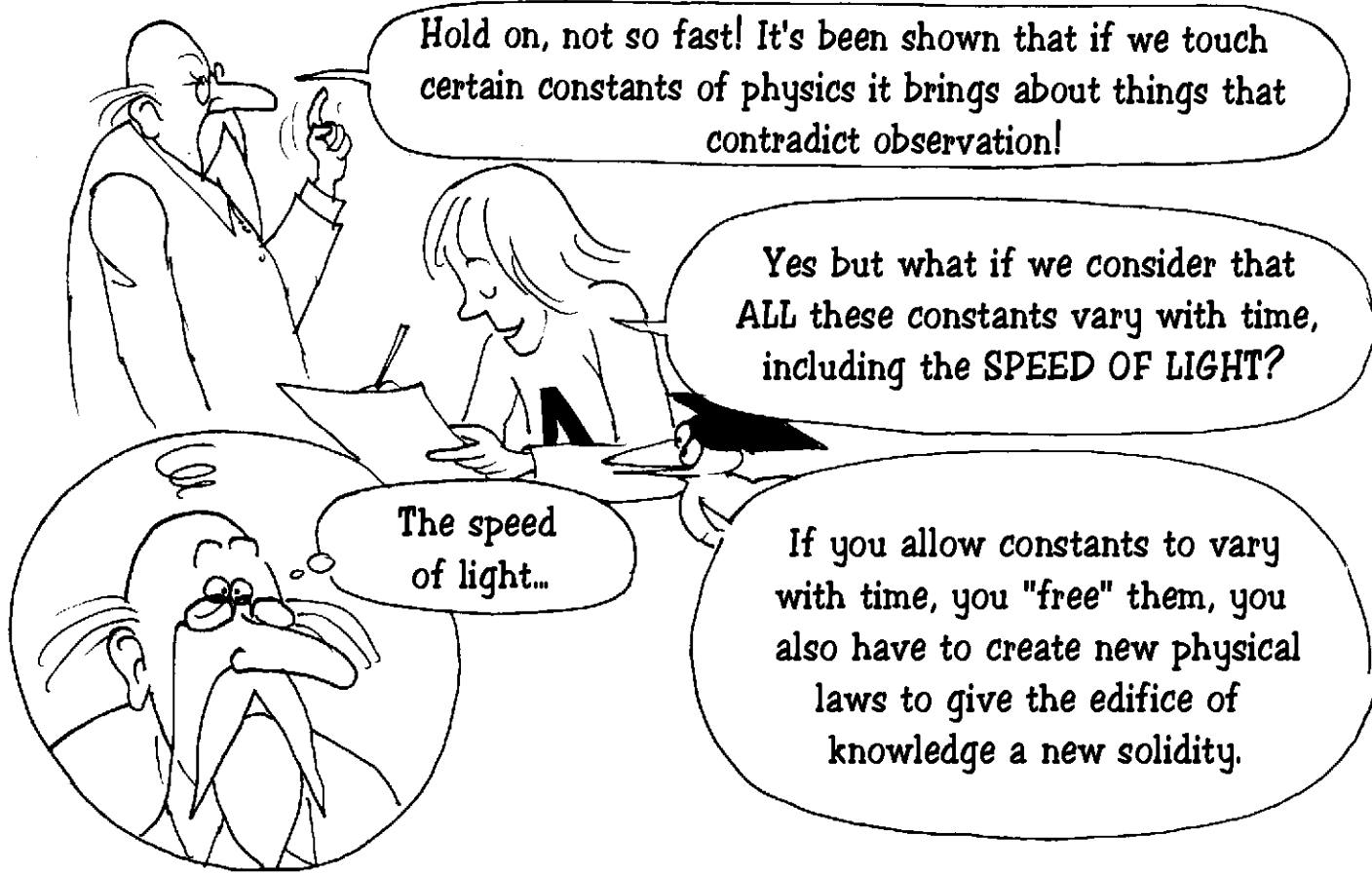
An axiom is nothing more than a
belief with a stiff collar and a tie.

You mean to say that at the beginning of the 20th century we were able to
make the first precise measurements of these quantities, which entered into
equations, some of them actually being discovered then, and that afterwards a
tacit **CONSENSUS** was established postulating their **ABSOLUTE CONSTANCY**?

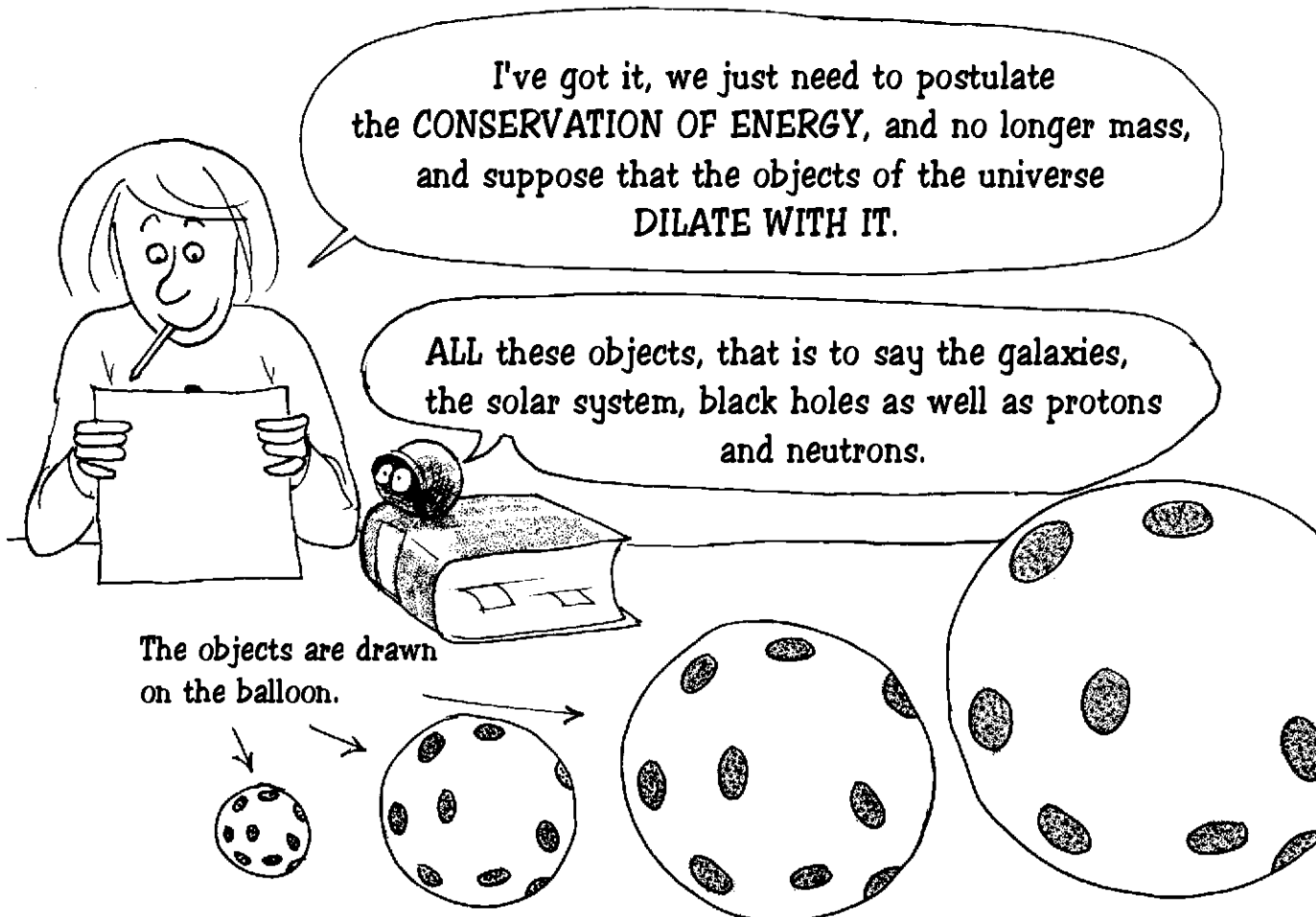


What difference does it make Leon? Man has always
wanted to limit the Universe to his fantasies of the
moment. There were the famous polyhedra of Plato (*),
the four elements. Today it is these constants of physics.

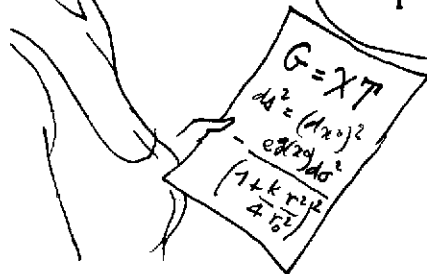
(*) See 'Cosmic Story', page 26.



SUPER-RELATIVITY

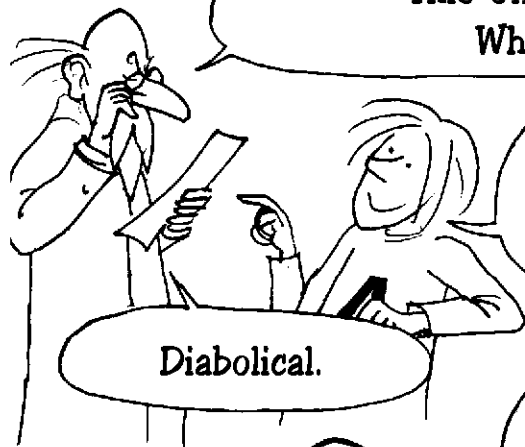


Effectively that will give an infinite speed of light $t=0$ which continuously diminishes subsequently (*).
The mass increases but energy mc^2 remains constant.
The constant of gravity varies as the inverse of mass...
and all that is a solution for the **GENERAL RELATIVITY** equation of the famous **EINSTEIN EQUATION**.



There's a thing!?!)

This Universe model is a monster, a chimera.
What do you do with **RED SHIFT**?



Diabolical.

Look, there it is!
We find that Planck's constant varies like t ,
so we get back to **MILNE's** idea.

Let's see... the photon is emitted with a certain **ENERGY** $h\nu$, that it conserves.
During its journey Planck's constant h increases, therefore frequency ν , as it will be measured at its reception, will be different (**). Hmm...odd!...

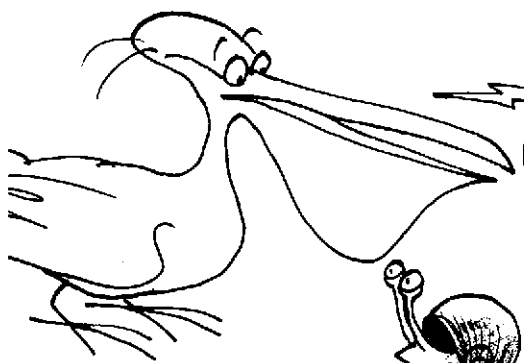


Clack!

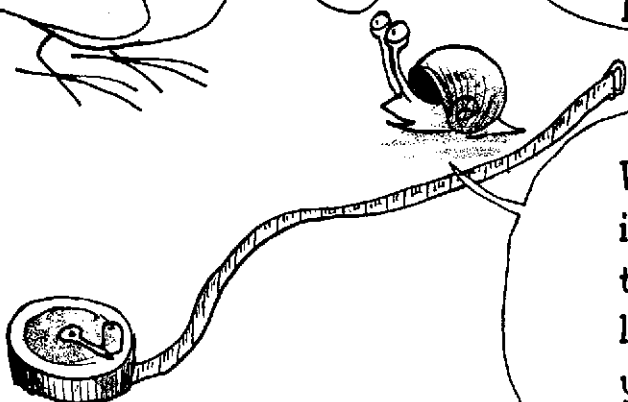


(*) In this model the speed of light C varies as $1/\sqrt[3]{t}$.

(**) The shift $\Delta\nu$ of frequency is proportional to the distance to the source.
This brings us back to **HUBBLE'S LAW**.

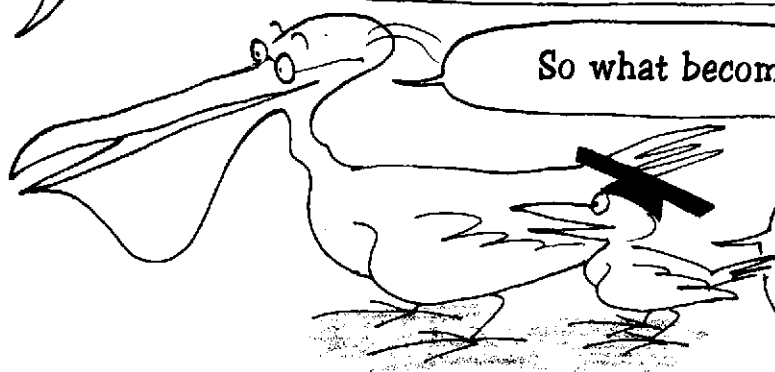


But...if the red shift is no longer due to the Doppler effect of the recession speed of the sources, then the Universe is no longer in expansion surely? I can't understand anything anymore...



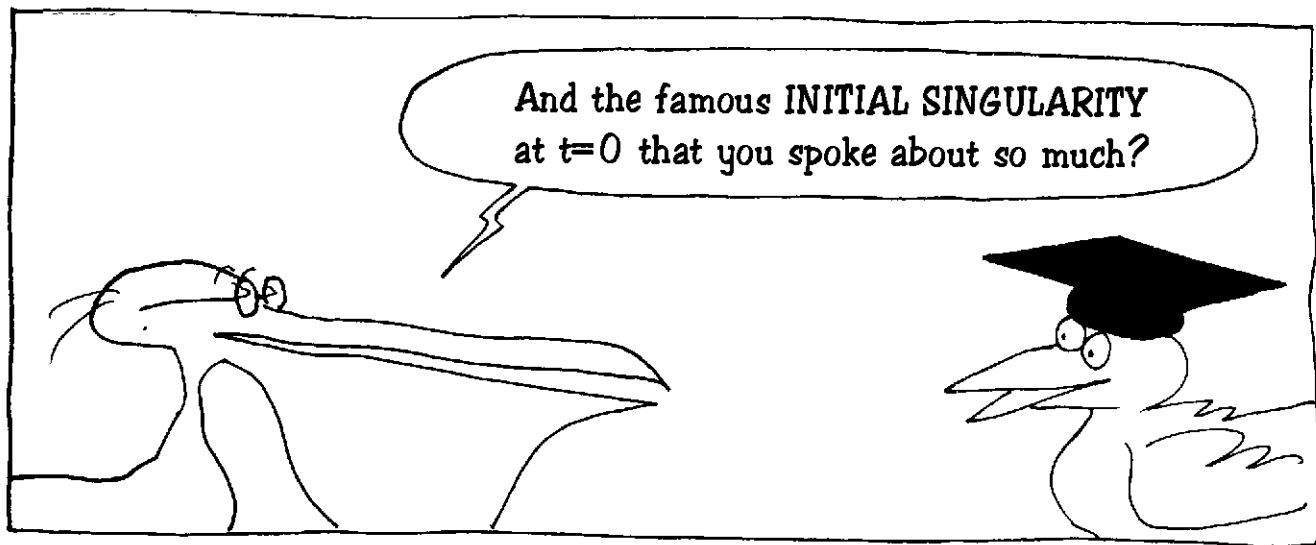
We don't care! The only thing that matters is to get back to what is observable, the red shift. In this model you can no longer **MEASURE** any expansion because your tape measure will dilate at the same time as the Universe does.

In the same way it is impossible to show variations of h , c , G , m etc **LOCALLY** because the measuring instruments, based on these same constants, drift "in parallel".



So what becomes of **ENTROPY**?

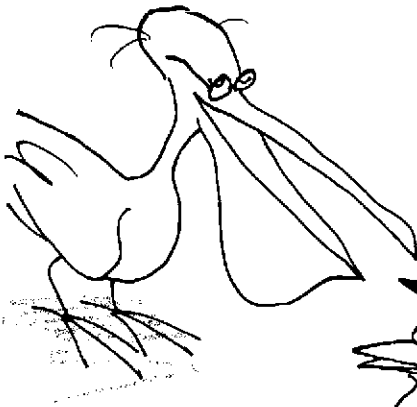
It increases with time t (*). The paradox of page 36 falls.




And the famous **INITIAL SINGULARITY** at $t=0$ that you spoke about so much?




(*) In this model entropy S varies as $\text{Log } t$ (Annex F).



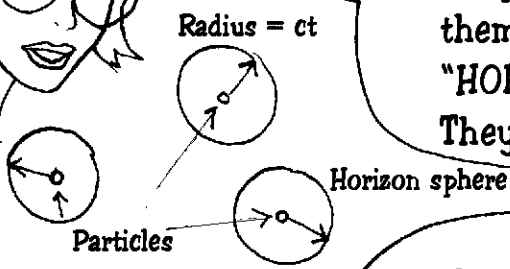
If we swap the **CHRONOLOGICAL VARIABLE** t for **ENTROPY** S the singularity no longer exists, because then this so-called "INITIAL INSTANT" corresponds to $S = -\infty$ (*). The Question of the state of the Universe **BEFORE** the big bang becomes meaningless.



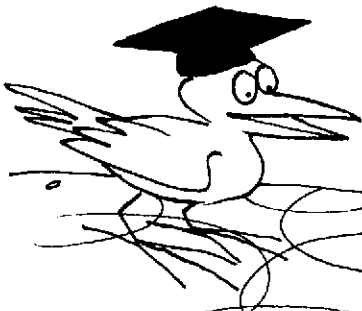
Which means that **TIME** will not be the right **VARIABLE** to describe the **EVENTS** but a sort of illusory mirage.



Well as we're attacking paradoxes...we saw on page 36 that no-one knows how to explain the apparent disorder and remarkable homogeneity of the Universe because, when it was young, particles completely ignored each other.



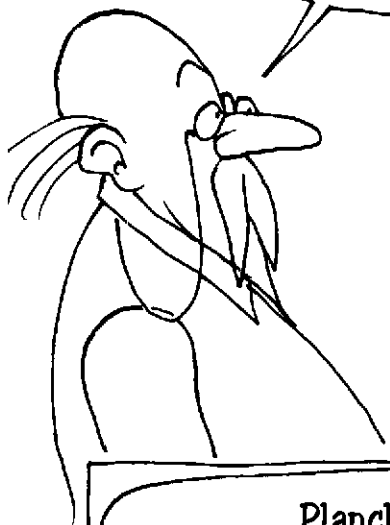
These particles emitted a luminous wave, at speed C and at time $t = 0$, but they distanced themselves so rapidly from each other that their "HORIZON SPHERES" did not interpenetrate. They are in a state of perfect **AUTISM** (*)



However, in **SUPER RELATIVITY** the horizon spheres interpenetrate during every epoch, they grow at the same speed as the Universe itself. Particles interact. **DISORDER** and **HOMOGENITY** are thus justified.

(*) Psychiatry : Total absence of communication with others.

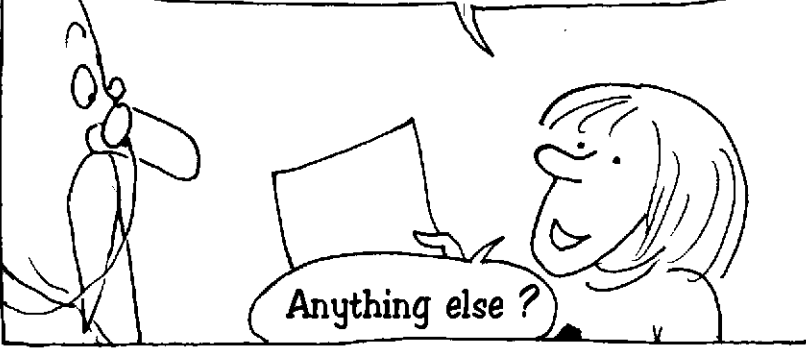
And Planck's time, that remains a problem all the same !
You can't get rid of all the paradoxes?!?



Let's see, this time equals $\sqrt{\frac{hG}{c^5}}$,
a second, I'm looking...



Planck's time varies like... t !
Planck's barrier disappears (*)



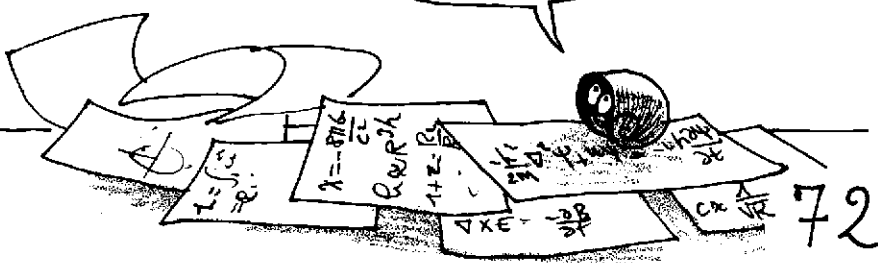
Anything else ?



Tiresias, where's Archibald ?



I think
he's up there.

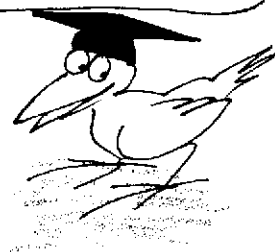


(*) See Annex F.



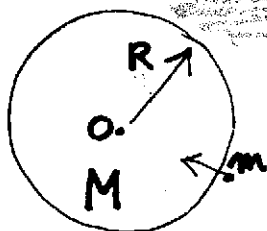
Modern science has the reputation of being built from dreadfully complicated equations that only a very limited number of "brain boxes" can understand. But fundamental ideas are always very simple and can often be illustrated perfectly well with calculations similar to those of shopkeepers.

The following notes are examples of this.



Annex A

Or how to capture the law of evolution of the Universe in three lines of calculation.



Let us assimilate the Universe to a homogenous lump of dust with a radius R and a mass M . Let us consider a grain of dust of mass m on its surface.

We can show that the force exerted on this mass is the same as that produced by all the mass M concentrated in the centre O , that is to say $F = -GMm/R^2$

Let's apply the $\vec{F} = m\vec{\gamma}$ of mechanics.

That gives : $-mR'' = GMm/R^2$ where : $R''R^2 + GM = 0$

In other words the famous FRIEDMAN EQUATION.

Let's build one of three solutions to this differential equation.

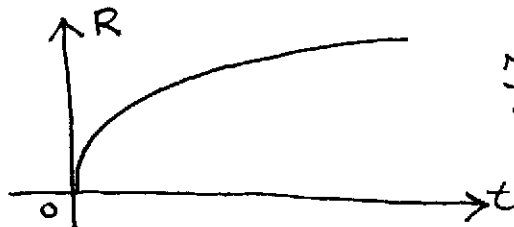
Let's give for the function $R(t)$ the form at^b , where a and b are two constants yet to be determined.

$R = at^b$ then $R' = abt^{b-1}$ then $R'' = ab(b-1)t^{b-2}$

We put it in the equation and get: $b(b-1)a^3t^{3b-2} + GM = 0$ which should "work" whatever t is.

The only solution : The exposant of t must be nil, so $b = 2/3$ which gives $a = \sqrt[3]{9GM/2}$ and $R = \sqrt[3]{9GM/2} t^{2/3}$

$R(t)$ is the characterisic length of this universe, which could be compared to either its radius of curvature or the average distance between two particles.



Annex B

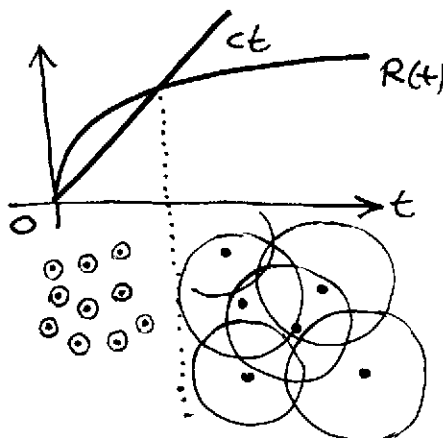


The autistic universe.

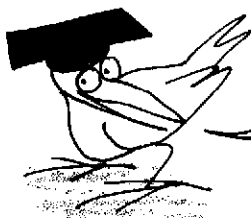
A glance at the curve $R(t)$ shows that the expansion of the Universe began with an explosion, the speed of expansion gradually slowing from then on.

If we take $R(t)$ as the average distance between two particles, ct represents the radius of the electromagnetic wave emitted at the instant $t=0$.

With a constant speed of light we see that the radius of this 'horizon sphere', or knowable sphere, will remain inferior to the average distance between particles for a certain time, and these particles will ignore each other totally during this period.



Annex C



How to calculate the radius of a BLACK HOLE

Take a star with a radius R and a mass M with a mass m at its surface. Let us suppose that this is a rocket. The energy that it can use cannot exceed mc^2 , which represents its equivalent in energy. Let's calculate the energy that must be expended to allow this mass m to escape the star's gravity.

The force is $F = -GMm/r^2$

The work is $-GMm/r^2 dr$ where dr represents a small movement

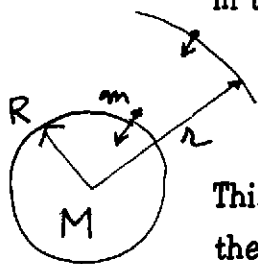
The energy required is $E = -\int_R^\infty GMm/r^2 dr = GMm/R$

This energy will exceed the maximum energy available if : $GMm/R > mc^2$ then $R < GM/c^2$ (Schwarzschild's Radius).

A more precise calculation, taking the reduction of mass into account, would give the exact value $R_s = 2GM/c^2$

If a mass M is contained within its Schwarzschild Radius, no object will be able to leave it because the energy required is superior to mc^2 .

The SCHWARZCHILD RADIUS of the Sun is 3.7 km.



A photon has an energy $h\nu$.

It represents a quantity of matter equivalent to $m_\phi = h\nu/c^2$

with which we can calculate its extraction energy : $-\int_R^\infty GMm_\phi/r^2 dr = (GM/Rc^2) h\nu$.

The energy of a photon managing to leave the star is : $E' = h\nu(1 - GM/Rc^2) < h\nu$

Gravitational red shift phenomenon

If $R < GM/c^2$, the star cannot emit light. It's a black hole.

Annex D



And now let's go
to Planck's conditions.

The spacial extension of a particle with mass m is given by the COMPTON length $\lambda_c = h/mc$. Let us suppose that the particle is a black hole. Then this length λ_c should be identical to the Schwarzschild radius, that is to say: $h/mc = Gm/c^2$, which gives $m_p = \sqrt{hc/G}$, which equals 10^{-5} grams. No heavier particle can exist. Then its radius is

$$h/mc = h/c\sqrt{G/hc}. \text{ That is } L_p = \sqrt{hG/c^3}.$$

That's PLANCK'S LENGTH $1,610^{-33}$ cm. Nothing smaller can exist in the Universe

It is the elementary stitch
in the universal pullover



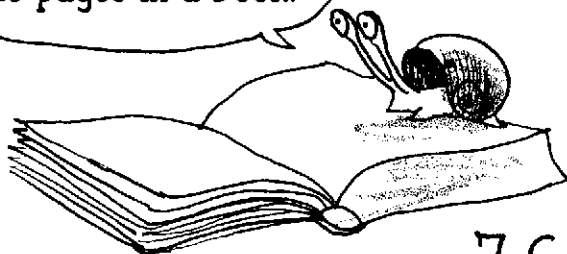
That is a photon with a wavelength of $\lambda = c/\nu$. Its energy is $E = hc/\lambda$ and its equivalent mass $m_\phi = E/c^2 = h/\lambda c$. Its Schwarzschild radius is $R_s = Gm_\phi/c^2 = Gh/\lambda c^3$, which is equal to its wavelength if $\lambda = \sqrt{Gh/c^3} = L_p$.

When a photon's wavelength is equal to its Schwarzschild radius it starts to go round and round like a dog trying to catch its tail and information can no longer circulate.

At that length we associate the time $t_p = L_p/c = 0,5410^{-43}$ seconds.

It is the THICKNESS
OF THE PRESENT

The thickness of
the pages in a book.

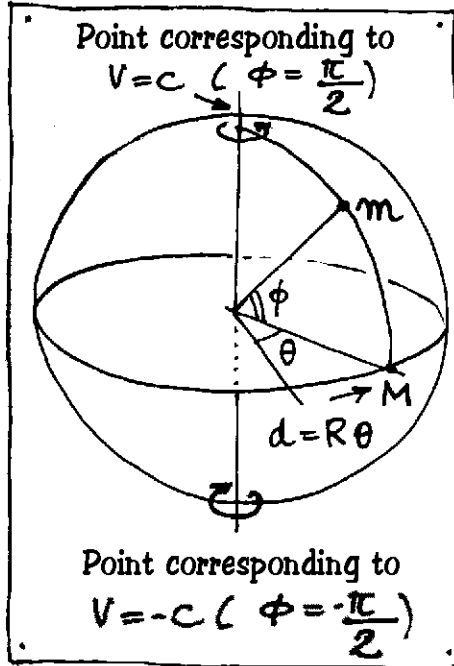


ANNEX E

THE RELATIVIST PHASE SPACE

It will be curved, both in its position and its speed. We will limit it to one position dimension and one speed dimension.

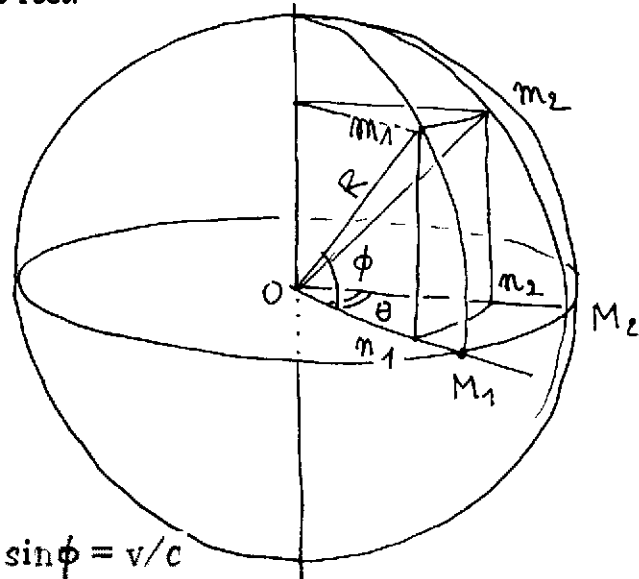
The position will be noted by the marker θ and the speed by the marker ϕ .



For an immobile observer the displacement of an object at speed V will be $d = R\theta$ and its speed will be linked to the angle ϕ by the relation $V = c \sin \phi$.

For this observer the photons will encircle the poles following trajectories of zero length (See "Everything is relative").

That is $\widehat{M_1 M_2} = R\theta$ in displacement, as seen by an observer at rest.



In the space phases the real displacement corresponds to the arc $\widehat{M_1 M_2}$ which is projected in the equatorial plane according to the arc $\widehat{n_1 n_2}$.

The segment $on_1 = R \cos \phi$

The arc $\widehat{n_1 n_2} = \widehat{on_1} \theta$ as $\cos^2 \phi + \sin^2 \phi = 1$ and $\sin \phi = v/c$

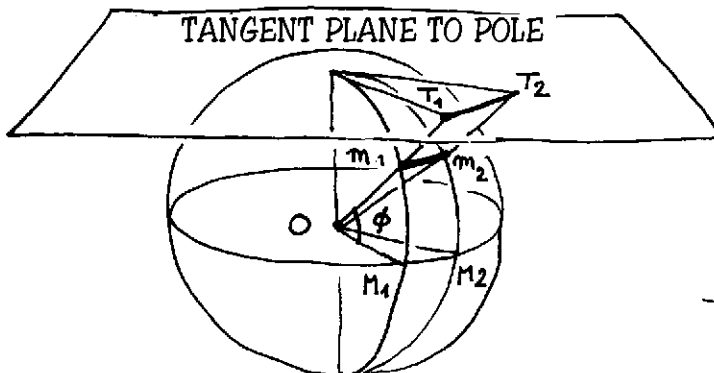
We get:

$$\widehat{m_1 m_2} = \widehat{M_1 M_2} \sqrt{1 - v^2/c^2}$$

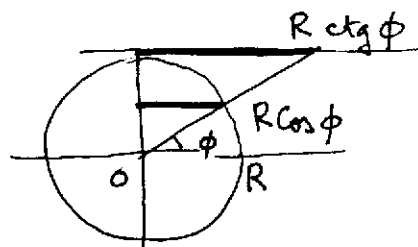
Which is none other than the famous LORENTZ CONTRACTION.

In the phase spaces time isn't a free variable. PROPER TIME is calculated.

It's proportional to the arc $\widehat{T_1 T_2}$, projection of the arc $\widehat{m_1 m_2}$ on the tangent plan at the pole.



$$t = \widehat{T_1 T_2} / c = (\theta R \operatorname{ctg} \phi) / c$$



The speed V is the relation displacement/duration $\frac{\widehat{m_1 m_2}}{T_1 T_2} c$ then

$$V = c \frac{R \cos \phi}{R \cot \phi} = c \sin \phi$$

ANNEX F

SUPER-RELATIVITY

We "give their freedom" to all the "constants" of physics.

For example, G , the constant of gravity; h , the Planck constant; c , the speed of light, m the mass of the proton or neutron.

In the equation of general relativity, Einstein's constant $\chi = -8\pi G/c^2$ is an **ABSOLUTE CONSTANT**. Therefore $G \approx C$ (\approx means "varies as")

We suppose that energy mc^2 is conserved through time, m being the particle's mass when at rest.

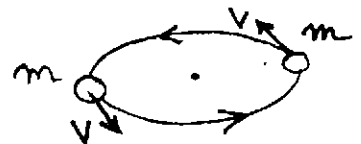
We suppose that the galaxies, the solar system, black holes, protons and neutrons "get bigger" at the same time as the Universe, whose perimeter is taken as equalling $2\pi R$

Let's write that the radius of a black hole (Schwarzschild's radius) increases as R and

then $Gm/c^2 \approx R$, as $G/c^2 = \text{cte}$, then $\boxed{m \approx R}$.

As does $mc^2 = \text{cte}$

$$Rc^2 = \text{cte} \quad \text{or} \quad \boxed{c \approx \frac{1}{\sqrt{R}}} \quad \text{and} \quad \boxed{G \approx \frac{1}{R}}$$



Let us take two stars of the same mass orbiting around a centre of gravity according to a circular trajectory of radius r .

The centrifugal force is mV^2/r , and mutual gravitational attraction is $Gm^2/4r^2$

If r varies as R , then $Gm^2/R \approx mV^2/R$, from which $\boxed{V \approx 1/\sqrt{R}}$.

The relation $\beta = v/c$ is conserved with time, just as is energy $E = \frac{mc^2}{\sqrt{1-v^2/c^2}}$

The spatial extension of the proton being given by its Compton length $h/mc \approx R$, we have:

$$\boxed{h \approx R^{3/2}}$$

The resolution of Einstein's equation, in supposing that the Universe is homogenous and isotropic (Roberts' or Walker's metric), leads to the differential equation :

$$\frac{2R''}{R} + \frac{R'^2}{R^2} (2 + \beta^2) + \frac{kC^2}{R^2} (1 + \beta^2) = 0$$



where $v = \beta c$ is the agitation speed of the galaxies in this "cosmological fluid".

In seeking a solution of the type $R = at^b$ we see that β eliminates itself and that $k = -1$ gives a solution $R \approx t^{2/3}$

k is the exponent of curvature

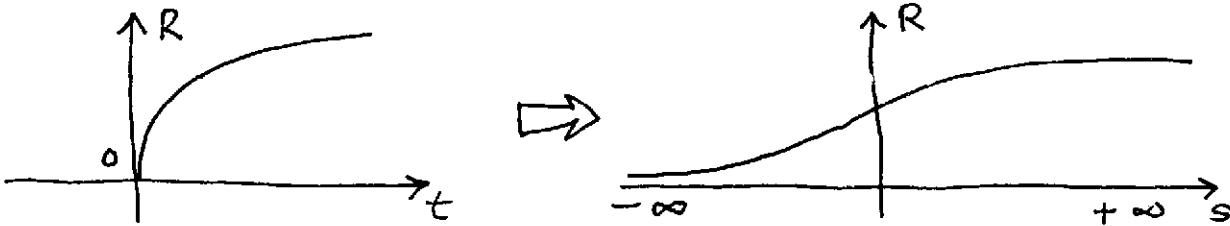
Therefore this universe has negative curvature (*)

The cosmological horizon is defined by the integral $H = \int_0^t c(\tau) d\tau$ and we find $H \equiv R(t)$.

Therefore the homogeneity of the universe is justified during every epoch

Entropy becomes $S \approx \log t$

In a description where entropy replaces the variable time, the initial singularity quite simply disappears



All the equations of physics (Schrödinger, Maxwell, Boltzmann) are invariant by the transformations obtained.

We find that the RED SHIFT is proportional to the distance (Hubble's law).

Up to a few hundred million light years ago, the distances calculated for sources are almost identical to the distances of the classical model

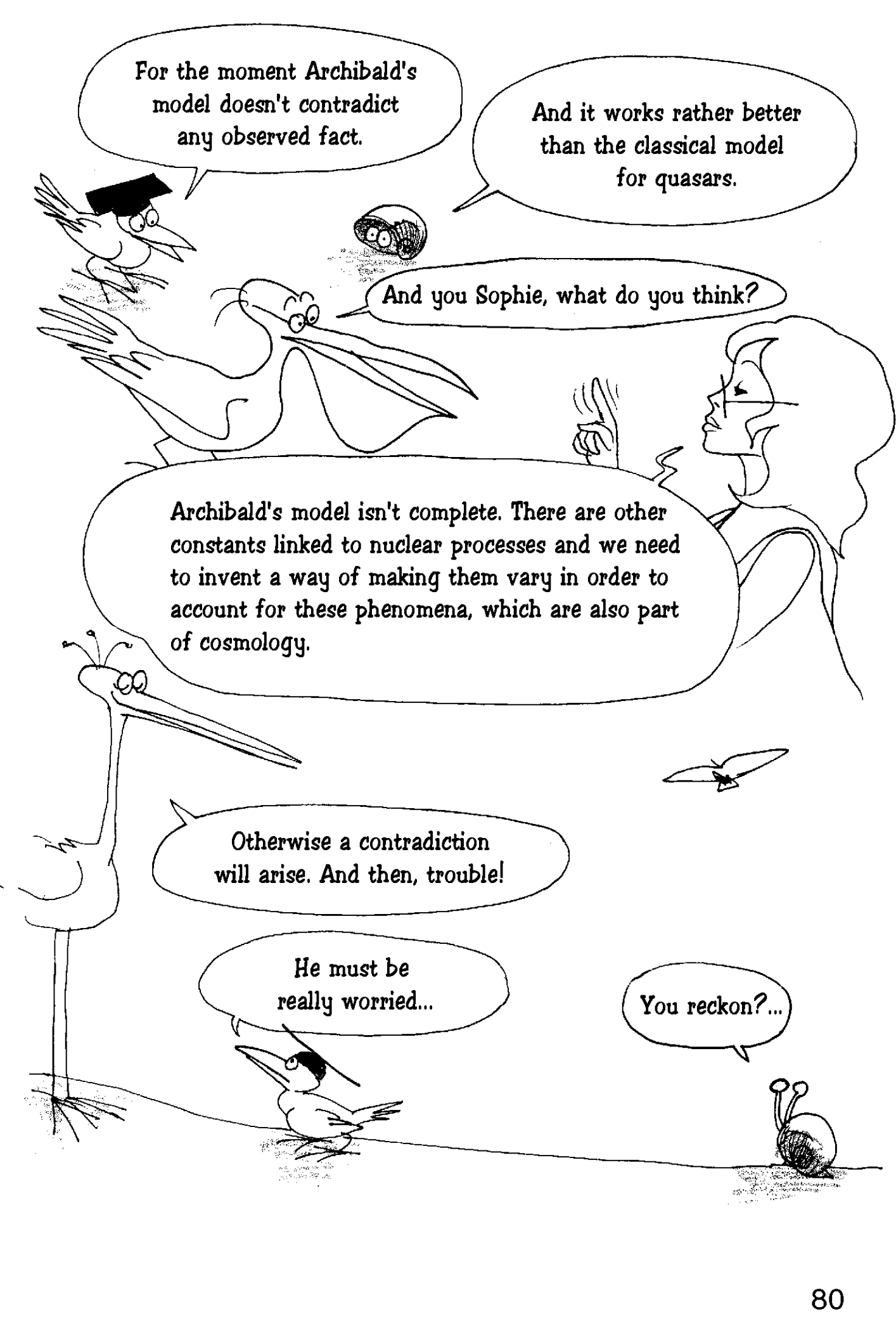
It being supposed that the energy of photons $h\nu$ is conserved (like all energies) as

$h \approx t$ then $\nu \approx 1/t$.

The red shift is no longer a consequence of the Doppler effect but proceeds from the secular drift of Planck's constant.

In 1988 Barthel and Millet ("Nature", vol.333, May 1988) showed that the further quasars were, the smaller they were. This fits in with the model where quasars "grow" with the Universe itself.

(*) See "The Geometricon" and "The Black Hole".



For the moment Archibald's model doesn't contradict any observed fact.

And it works rather better than the classical model for quasars.

And you Sophie, what do you think?

Archibald's model isn't complete. There are other constants linked to nuclear processes and we need to invent a way of making them vary in order to account for these phenomena, which are also part of cosmology.

Otherwise a contradiction will arise. And then, trouble!

He must be really worried...

You reckon?...